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Volume 94 June, 1920 No. 6

CONTENTS

EDITORIALS:

Strictly a Business Proposition....322
An Inevitable Comparison....323
The Business Viewpoint....323
Stresses in Locomotive Running Gear....323
Conventions and Committees....324
Car Wheel Grinding....324
Breakage of Locomotive Cylinders....325
Adequate Reinforcing for Cars....325
The Responsibility of the Unions....325
New Books....325
What Do You Think?....326

COMMUNICATIONS:

Editorial on Service of Supply Draws Fire....327
Handholes vs. Washout Plugs....327
Women in Railway Shops....327
Specifications for Soft Metal Bearings....328
I. A. Learns Some Things About "Passing the Buck"....328
The Shop Wage Agreement....329
Increased Mileage from Assigned Engines....329
Inflated Tonnage Ratings....330

GENERAL:

The Railway Situation in Germany....331
M. C. Builds Engine Terminal at Niles....339
Automatic Machines an Aid to Economy....344
Air Brake Association Holds Live Convention....348
Economies Possible by Car Wheel Grinding....355
Railroads Need Modern Machine Tools....359
Lubrication of Soft Metal Bearings....362
Railway Equipment in South America....364
Inspection of Freight Equipment....369
Cost Accounting the Key to Cost Control....374
American Welding Society Holds Convention....380
Economy at Stationary Boiler Plants....381
Production of Lathe and Planer Tools....384
How the Master Mechanic Increased Production....386
Fort Wayne Heat Treating Plant....389
Taking Up the Slack in Production....392
Air Consumption of Locomotive Auxiliaries....395

SHOP EQUIPMENT:

High Power Multispeed Planing Machine....400
Automatic Chucking and Turning Machine....401
Universal Index Centers with 10-in. Swing....402
Air Operated Combination Three-Jaw Chucks....403
A Powerful Vertical Type Milling Machine....404
Machine for Correct Tap Grinding....405
Nine Speed Geared Head Engine Lathe....406
Saw with Inserted High Speed Steel Teeth....407
Electrically Driven and Controlled Planer....407
Side Cutting Pliers with Renewable Jaws....408
Production Automatic Milling Machine....409
Compression Coupling Saves Time and Labor....410
High Power Selective Head Engine Lathe....411
Boring Mill for Heavy Accurate Work....412
Small Portable Pneumatic Tools....413
Vortex Paint Spraying Equipment....414
Air Required to Operate Preheaters....414
Large Capacity Multiple Spindle Automatic....415
Exceptionally Large Plate Bending Rolls....417
Pilot Brush Increases Gage Life....418
Powerful All-Geared Head Engine Lathe....418
Staybolt Cutter and Yoke Type Riveter....419
Two New High Speed Milling Cutters....420
Vertical Shaper for Tool and Die Work....421
Cooler for Lubricating and Quenching Oils....422
Cincinnati Geared Head Lathe....422
An Adaptable Drill Steel Furnace....423
Self-Contained Motor-Driven Grinder....423
Short-Cut Lathe of Improved Design....424
Universal Shaper with Unit Gear Box....424
Snap Thread Gages for Accurate Inspection....425
Hydraulic Rail Bender of 35 Tons Capacity....426
Potter & Johnston Vertical Type Automatic....426
General Purpose Automatic Extension Reel....427
Independent Pneumatic Motor Hoists....427
Electric Rivet Heaters for Railway Shops....428

GENERAL NEWS:

Notes....429
Meetings and Conventions....431
Personal Mention....432
Supply Trade Notes....434
Catalogues....436

EDITORIALS

Notice

Notice is hereby given that the services of Clayton L. Smythe as circulation manager of this publication have been discontinued by us and that he does not now in any way represent the company or any of its publications.

Strictly a Business Proposition

THE June conventions at Atlantic City this year will surpass all records in every respect. Under the new form of organization and with the war excitement behind us, it has been possible to give much better attention to the preparation of the reports and to the rounding out of the program. The action of the Railroad Administration last year in encouraging a more general attendance of mechanical men met with cordial approval; moreover a large number of executive officers visited the meetings and looked over the big exhibit and were so greatly impressed that they indicated that they would encourage an even larger attendance this year. The exhibit space for the coming convention has been extended to include the balcony in the large main entrance hall on the pier and will cover almost 100,000 sq. ft. Even then a large number of concerns have had to be turned away because of lack of space.

Section VI, Purchases and Stores, of the American Railroad Association, will meet on the last three days of the mechanical convention, and this will not only add largely to the number of railway men in attendance, but in these three days and the preceding Saturday the exhibit will be crowded. As usual the Association of Railway Electrical Engineers will meet on Monday of the second week of the convention.

The expense of arranging for this big meeting and sending the delegates to Atlantic City will mount into hundreds of thousands of dollars. The *Railway Mechanical Engineer* believes that this expenditure is very much worth while, but it would like to take this opportunity of offering a few suggestions with a view to helping to get the greatest possible return from this great expenditure.

In the first place, what is such a convention for? Is it not primarily for intensive educational work coupled with the great inspiration which accompanies attendance at such meetings? This, if rightly directed, will result in more economical and efficient operation; if it does not show concrete results in this respect it will be extremely difficult to justify the continuation of the conventions on the present scale.

Who should go to the conventions? Every responsible mechanical department officer who can be spared from the job for part or all of the time, and particularly the ambitious, energetic young men who in a few years will be in line to fill more responsible positions. Many a young man has found himself at these meetings and has gone back to his job with an enlarged vision of the possibilities before him and a will to do. The railroads, particularly in these days, can ill afford to miss an opportunity of enlisting the enthusiastic support of young men of this kind. Any expense involved in their attendance at the Atlantic City conventions will be insignificant compared to the possible returns.

What should be the attitude of the delegates to the conventions? No railroad executive will authorize the investment of money unless it will bring a good return—at least 10 per cent—on the investment. The railroad man going to the conventions should realize that in order to make the trip worth while he will have to insure a good return on the cost of sending him to the meetings and paying his salary and expenses during that time. It is simply a cold-blooded business proposition and it adds an element of real sport to the occasion.

How can one get the greatest possible good from the convention? No one really attains any worth-while end unless he has a goal or definite objective constantly before him. It is not enough that a man go to the convention with good intentions and a disposition to profit by his attendance. He must go with the very definite object in his mind of trying to improve some troublesome condition or of increasing the efficient working of some part of the work in which he is interested. He may get help in solving his particular problem or problems in the convention hall; or it may be in interviewing men engaged in similar effort on other roads; or it may be in studying some of the exhibits, or in talking matters over with the engineers or service men of the railway supply companies; it may even be in conversations on the trains going to and from the convention. Too many men get into a rut and keep their noses so close to the grindstone that they miss big opportunities of profiting by the experiences of others. There are many striking examples on record of men who have been forcefully kicked out of the rut by mixing with their fellows at the conventions.

Frank McManamy took the bull by the horns last year and through the regional directors asked all of the mechanical men to report on the things which they heard or saw at the mechanical conventions which could be applied to advantage on their own roads. Mr. McManamy's idea was to encourage the men to use their time to the best possible advantage and therefore justify the Railroad Administration in arranging for a record-breaking convention. Unfortunately there was more or less misunderstanding as to the purpose of these reports. It is to be hoped that this year the heads of the mechanical departments will instruct their assistants as to just what features each individual should specialize upon, and then that the reports be made either at a staff meeting on the return home or to the head of the department in writing.

A written report need not be formal, nor need it be long or complicated. What is the thing you recommend? Why? Where should it be applied? What will its installation cost? What are its limitations?

These questions may refer to a device or a method or practice of some sort. Fifty words may cover your recommendations, but you must put them up in such a way as to sell the idea to your boss. Give the definite data which will help him to draw a conclusion; otherwise the matter may be laid aside and forgotten.

Just a word to the supplymen. Those exhibits which are most novel, or which are so arranged as to attract special attention to the special advantages of the particular device or equipment, will of course make the most distinct impression. Have your best service men and engineering talent on hand to talk to the man who is right from the firing line

and is anxious to talk practical details. If you do not know the men, don't judge too much by appearances. The big boss is not always the most prepossessing in appearance or the best dressed man in the group. Some supplymen will tell you this, to their great embarrassment.

The supplyman must remember also that mechanical officers are looking for real dollars and cents arguments as to the value of a device. It is to your interest to see that they get the right kind of concrete data to incorporate in their reports.

The Atlantic City conventions offer wonderful opportunities for big gains in the more efficient and economical administration of the mechanical department. What part will you have in securing better results?

An Inevitable Comparison

MANY railroad mechanics and foremen are now contrasting their present condition with the situation in industrial shops. Industrial enterprises have generally been exceedingly prosperous in recent years and have found it possible to attract many experienced railroad men from the mechanical department. Under the circumstances it is inevitable that comparisons should be drawn at this time which are not always favorable to the railroad. The basis for this comparison is, however, not always a sound one. Industrial activity is now at its height and young men particularly are apt to overlook the possibility of a reversal in this state of affairs that will cause many of the less stable industrial shops to discontinue operations. Transportation has had its reversals, but it has always kept functioning and has tided the greater portion of its employees over years of severe business depression.

A further analysis of the situation will probably show that the policy of promotion on merit versus pull is, if anything, more generally observed by the railroads than industrial concerns. Except where industrials are organized on a very large scale the relation between ownership and operation is more intimate, from which it follows that promotion to executive positions is more often awarded to relatives and close personal friends of the owners than could possibly be the case on the railroads.

The operation of an industrial shop is generally more highly specialized than is the case with the typical railroad shop. This in itself appeals to many men, who prefer an even volume of routine work to the usual variety and emergency character of railroad work. The material situation is easily controlled in a factory manufacturing a single article and industrial shops generally appear to be in better running order than the average railroad shop, but is it to the advantage of the young man to be employed in a shop where every operation is planned for him and initiative is entirely in the hands of a production engineer? It might be advantageous for the railroad shop if a higher degree of scientific management prevailed, but it is doubtful if this would tend to develop the same energetic and resourceful men on whom the railroads are today so dependent.

There are other factors in this comparison between railroad and industrial shops that are less in favor of the railroads and with respect to which there is room for improvement. Industrial shops are generally housed in better structures, they are better lighted, better heated, better arranged and more sanitary than the average railroad shop. They are often located in the very center of a residential section that is admirably suited to the requirements of the employees, whereas railroad shops, if not located in some untenantable district adjoining railroad yards, are so far removed from any habitable center that the shop train must be resorted to in order to transport the employees to and from work. While location may be governed by conditions over which the railroads have little control, there is no corresponding reason why some of the community and welfare work promoted by industrial concerns cannot be undertaken by the railroads. To what extent are the railroads studying the personnel of their employees? How many mechanical executives have ever studied their labor turnover as compared with that of an adjoining railroad or a neighboring industry? The railroads are now in a position to do as much if not more for their employees, particularly the young men, as any industry, and this is a fact that must be made apparent to every one of their employees if the railroads expect to keep abreast of industrial development.

The Business Viewpoint

THE extent to which mechanical executives can contribute towards making the operation of their railroads profitable depends entirely upon the extent to which they acquire the business viewpoint. Probably the best way to get this viewpoint is to consider how a new device, a new shop, or a new method would affect your pocketbook if you were the proprietor of the company. If you were convinced that a new device will save its cost in fuel and wages within a period of two or three years, would you not try very hard to make its operation a success? On the other hand, if it was determined that a new shop would cost one million dollars to build would you not want to be very sure that it would effect a real saving of at least one hundred thousand dollars per year before you would commit your company to this investment at the current rates of interest? How many mechanical men appreciate the fact that an increase in the material stock of a million dollars costs the railroad at least seventy thousand dollars a year? Possibly you would scan material requisitions more rigidly than the purchasing agent if your income depended on the company's annual surplus.

Have mechanical executives lived up to their opportunities; have they grasped the business viewpoint? Have the recommendations of the mechanical department always condemned unprofitable investments in mechanical equipment and fought for profitable expenditures, or has this question been left to the decision of a higher executive?

No official on the railroad has a greater opportunity to make the operation of his property profitable than the mechanical superintendent; no official has a better claim to executive rank; and, provided he acquires the business viewpoint, no official will advance more rapidly in authority over the operation of the railroad.

Stresses in Locomotive Running Gear

IT is the general practice in designing locomotive running gear parts to allow a large factor of safety even with stresses based on safe values for carbon steel having low elastic limit and ultimate strength. The design of these parts is largely empirical; and while on large modern locomotives the parts are extremely heavy, due to the low stresses employed, very few roads have made any serious attempt to reduce the weight of rods and pins by the use of high grade materials. On account of the excessive weight of these parts many locomotives built in recent years are very difficult to maintain. While the boiler proportions are excellent and the operating results generally satisfactory, the design of the machinery from an engineering standpoint is a reproach to the mechanical officers.

The time has come to get out of the rut and to take a step forward. Alloy steels have been used on some roads with excellent results and more work should be done in developing their use, but the prejudice against the general use of a new material may retard the general introduction of alloy steels. There is no reason why higher stresses should not be used

in designing carbon steel parts, as it is possible to increase the strength of carbon steel forgings to a remarkable extent by proper working and heat treatment. A series of tests recently conducted on a forging seven inches square showed that by proper treatment the yield point could be raised from 45,000 lb. to 87,000 lb. per square inch. The resistance to impact showed a remarkable increase, the average energy required to fracture the bar when quenched and drawn at the proper temperature being more than seven times as great as that which caused fracture in the material as forged from the ingot.

The low elastic limit and ultimate strength in large forgings are no doubt due to the tendency to work the larger sizes at higher temperatures than the smaller sections. The direct result of this practice is to reduce the ability of the larger parts to withstand shock. The proper forging temperature of approximately 1,000 deg. C. or 1,830 deg. F. renders the material sufficiently plastic for thorough working by forging presses, though the power hammer is effective only in breaking up the crystallization near the surface.

A better appreciation of the effect of mechanical working on the properties of carbon steel would be secured if the impact tests were more generally used. Thorough working does not greatly alter the values obtained from tension tests, but impact tests show the remarkable increase in the ability to withstand shocks. The reduction of the dynamic augment is one of the most important questions now confronting the locomotive designer. The reduction in the weight of parts through improved design has probably been carried as far as is practicable. It is to be hoped that measures will be taken to lighten locomotive parts through the use of material which will withstand higher unit stresses.

Conventions and Committees

WITH several important conventions over and the June conventions at Atlantic City just ahead, it might be well to take account of some of the objects and a few of the results to be derived from any convention of railway mechanical men. The conventions must not only advance the knowledge of mechanical progress in transportation, but must broaden the outlook on all mechanical matters. The fact that a new method or a new device is making good on a single road should inspire mechanical men all over the country to ignore the immediate objections or the added complications and make this new method or device a success for the ultimate welfare of their own road. That a paper on train loading presented before a recent convention should be made the subject for discussion at a staff meeting of division officers is in itself proof that the good effect of conventions is far-reaching. No good paper on such matters as train loading, feedwater heating, improved shop methods or shop tools should become mere literature after the convention is over; it should be considered at the earliest possible staff meeting and continue to be a live topic on every railroad.

The task of writing the reports that go before these conventions should be taken very seriously by the committees to whom they are entrusted as they are a guide to individual practice on many roads. Every report represents an opportunity to effect an improvement in existing practice—sometimes a very great improvement—and the failure of a committee to put its best effort into a report or to cover the latest and most improved practice is an opportunity lost. There is need generally for a better working agreement between committee members and the chairman, so that the burden of preparing a report will be more evenly distributed and the report will more nearly represent the individual opinion of each member. It is suggested that this situation might be improved by permitting a chairman some part in selecting the other members of his committee.

Reports should be written so that they can be applied to specific problems, and will present the most advanced and dependable information on the subject to those who are seeking instruction. Committee members cannot know how much help their reports give to others, because they may have a far wider distribution than they suspect. But if the report is written to be used, it will be used. It may be discussed not only at staff meetings but at directors' meetings, and should be constructed accordingly.

Car Wheel Grinding

MACHINES for grinding the treads of car wheels have been used in the railway shops of this country about fifteen years, but in spite of this long test period which demonstrated their value, these machines have by no means come into general use. In fact one of the leading manufacturers, has made only eleven installations of car wheel grinding machines in steam railway shops in the United States. There are three possible explanations for this situation: (1) the possibilities in car wheel grinding are not realized; (2) the railroads are not in a financial position to purchase machines; or, (3) the practice is not as successful as some authorities claim. The last explanation is refuted by an article in the present issue which shows how long it takes to grind car wheels, what kind of wheels should be ground and the resultant saving effected. It is hoped that this article will convince many mechanical department men, hitherto sceptical on the subject.

Most of the car wheel grinding done in the past has been confined to chilled cast iron wheels with flat spots developed in the treads due to sliding. Provided a wheel is not otherwise defective experience has shown it is practicable to remove flat spots up to 3½ in. long by grinding. Owing to the fact that the depth of chill in a chilled cast iron wheel is limited, it is obvious that a longer flat spot can be ground out of a new than a worn wheel without going through the chill. The condition of the flange is also a limiting factor. According to the article referred to a substantial saving is effected by reclaiming chilled cast iron wheels by grinding.

All machine tools including car wheel grinders have increased in cost approximately 100 per cent in the past four years and it is plainly shown in the article that in order to pay heavy interest and depreciation charges the machine must be kept busy as much as possible. The maximum saving per pair of wheels is dependent on the ability to keep the machine in operation eight hours a day. Inasmuch as the average time of grinding a pair of cast iron wheels is 38 minutes, this requirement would mean that any railway shop receiving as many as 12 or 13 pair of slid flat wheels a day can well afford the installation of a grinding machine.

But the field for car wheel grinding is not limited to the reclamation of flat cast iron freight car wheels. Chilled cast iron wheels are now used to a considerable extent on light suburban passenger cars. While these wheels are cast approximately true in the foundry, there is always a possibility of the tread being slightly eccentric with regard to the journal, due to improper boring. Furthermore, the slight raised chill marks on the tread produce a whirring sound at high speeds and may cause increased wear on the rail. These are serious objections and have been overcome by grinding the new wheels before going into service. This insures a smooth riding car, without objectionable noises. In addition, a greater mileage is claimed for the ground wheel. The grinding of new chilled cast iron wheels has been extended also to wheels used on box cars, refrigerators, stock cars and caboose cars.

Car wheels with wrought steel tires are usually turned when the treads or flanges become worn and this practice is undoubtedly advisable and indeed necessary if the wheels are badly worn. For wheels that are only slightly worn,

however, a cut must be taken sufficiently deep to get under the hard surface skin on the tread. With a grinding machine, it is possible to true up this tread, taking off just enough metal to remove the imperfection and the grinding method in this case results in a considerable saving of surface metal. Experience shows that it pays to grind wrought steel tired wheels that are slightly worn, the limiting feature being the amount of flange wear.

With the cast steel car wheel, the arguments in favor of grinding stand out more prominently than ever and especially in the case of wheels with treads of hard alloy steel. These wheels can be reclaimed by grinding should flat spots develop, but they are first ground before being put in service. The time required to grind new wheels is, on the average, twenty minutes which includes ten minutes required to set a pair of wheels in the machine. At that rate, it would be possible to grind twenty-four pair of wheels in an eight-hour day.

In view of the manifest advantages of having smooth, round car wheel treads concentric with the journals, it would seem a paying proposition to install machines for grinding new car wheels and there is no important railway shop that could not keep the grinder busy either on new wheels or reclaiming old ones.

Breakage of Locomotive Cylinders

THE breakage of cylinders on locomotives is among the troubles which have increased with the introduction of large engines. The universal use of piston valves may be partly responsible for this trouble, or it may be due in part to the proportionately smaller clearance volume on large cylinders. The major share of the blame, however, may be ascribed to improper cylinder cock rigging. Little attention is paid to the maintenance of these parts; the long connecting pipes are often not properly supported, and if there is more than the usual amount of resistance to the movement of the lever the connecting rods buckle or the levers bend, with the result that the cylinder cocks do not open. The inevitable result is frequent breakage of valve and cylinder packing rings, if the cylinder itself is not fractured.

Several devices are now in use which operate the cylinder cocks either by compressed air or by the action of the pressure within the cylinder. It would seem that a more general application of such devices would be justified in cases where difficulty is experienced in applying a satisfactory design of manually operated cylinder cock rigging. It must be realized that such changes are open to objection on the basis that they introduce additional complication on the locomotive, but the cost of new cylinders or of welding broken cylinders, together with the loss of service from the locomotive, is so serious that there should be no question as to the desirability of using such devices where excessive cylinder breakage is experienced.

Adequate Reinforcing for Cars

SO many expensive mistakes have been made in building cars of light and unserviceable construction that it should not be necessary to call attention to the ultimate economy of substantial design, particularly in underframes. The new cars built at the present time are in most cases amply strong, yet some roads which insist that new cars should be of more than average strength are still applying underframe reinforcement that is entirely inadequate for present day service. Experience has demonstrated that where a steel center sill is added to a wooden underframe, the steel member takes practically the entire force of the buffing shocks. The wooden sills assist in carrying the load, but they offer little resistance to end thrust and have only a slight tendency to prevent buckling unless the construction is designed with special regard for this detail. Therefore, any steel center sill applied to wooden cars should have sufficient strength, when considered as a column, to withstand the shocks it will receive in service without depending upon the other parts of the underframe to help carry the end load.

The argument is sometimes advanced that a weak car is not worth reinforcing with a heavy center sill. A heavy center sill costs but little more than a light one and the cost of application will in most cases be practically the same. The slight additional investment is therefore a minor consideration, for the heavy steel member will take the shocks which would otherwise rack the body of the car and soon make it necessary to repair or rebuild it. The problem of underframe design has been discussed by the Committee on Car Construction of the Master Car Builders' Association and if its recommendations were applied also to the design of reinforcing, many costly errors would be avoided.

The Responsibility of the Unions

FOR several months practically every railroad in the United States has been working under the wage agreement negotiated by the Railroad Administration, which provides for a written notice of any desired changes in the wages or working conditions. During that time numerous "unauthorized" strikes have been called by local officers of the unions without giving notice to the railroads. The adjustment of wages is now in the hands of the Federal Wage Board and provision has been made for the orderly settlement of disputes, yet there are still numerous "walkouts," and in every case the responsibility for getting the men back to work comes back to the railroad officers. It is not an uncommon occurrence for a superintendent of motive power to waste several days each month trying to settle strikes at isolated points on the road.

The present wage agreement is a contract in which one party, the railroad, apparently assumes all the responsibilities while the other party, the labor federation, exacts as much as possible but promises nothing in return. The unions give no assurance that their members will return a fair day's work for a day's pay and when the contract is violated by a strike, disclaim responsibility by stating that it is unauthorized. If the railroad violates its agreement the union secures redress by striking; when the union violates the contract there is no redress for the railroad. Is it not time that this one-sided arrangement was changed? Should not the responsibility of the labor organizations be more clearly defined and some provision made for holding them to the fulfillment of the obligations of their contract?

NEW BOOKS

Steam Power. By Hirshfeld & Ulbricht. 420 pages, 7½ in. by 5 in. Bound in cloth. Published by John Wiley & Sons, Inc., New York.

This book may be described as a text book, a handbook and a thoroughly up to date treatise on steam power and power plant practice. The subject matter has been more fully dealt with in hand books and previous volumes on the same text, but in this book the attempt has been made to collect within a single volume such parts of the subject as would be needed by engineers whose work does not require an intimate knowledge of thermodynamic principles. The book, however, does give a very good conception of the subject of entropy and other theoretical aspects of steam power. The authors have made frequent use of charts in connection with the subject of fuel and combustion problems, and the descriptions of boilers and boiler appliances as well as steam engines, turbines and auxiliary apparatus is very complete.

This book was designed primarily as a text book, but will answer very well as a reference book for engineers interested in modern power plant practice and the operation of railway stationary power plants.

What Do You Think?

WHAT do you think is the most instructive, the most interesting or the most readable article in this issue? If you would tell the editor occasionally it would help make the *Railway Mechanical Engineer* a more valuable as well as a more readable paper. What editorial in this issue appeals to you most? If you know of a subject that ought to be brought home to the mechanical department, don't hesitate to suggest it for editorial comment.

This issue contains a description of a new up-to-date engine terminal that has replaced inadequate facilities and equalized the length of operating divisions on the Michigan Central. What do you think about the engine terminal situation? Are not larger and better equipped engine terminals more urgently needed than almost any other improvement on your railroad?

If your chief interest is in shop practice you will find numerous articles that should be of particular interest in this issue. The broader aspects of the machine tool situation are discussed on page 359. The methods used by the Canadian Pacific for locating weak points in the shop are described in the article on "Taking Up the Slack in Production." If you are having trouble with your tools you may find some helpful suggestions in the description of the Fort Wayne heat treating plant.

Stationary plants have been among the most neglected parts of railroad shops. The article by Mr. Rogers tells how capacity may be increased and fuel consumption lowered.

How much money could your road save by making small parts in quantities and sending them out over the system? It is an important question and one which the article entitled Automatic Machines an Aid to Production should help you to answer.

Are you availing yourself of the economies that can be effected by grinding car wheels? If not you should read carefully the description of that practice in this issue. The Shop Equipment section contains descriptions of many shop appliances and you may find there just the machine you are looking for. If you are interested in reducing shop costs it is suggested that you read Mr. Armstrong's plea for more thorough cost accounting.

Do you know that Germany has more locomotives now than before the war? No article contributed to the popular magazines or daily press gives you a better insight into the state of affairs in Germany than the article on the railroad situation in that country appearing in this issue. Railroad welfare is so intimately identified with national welfare that Mr. Thayer's account of these railroads may convince you that Germany is getting back on her feet.

Is it not interesting to note "feed water heat surface" listed along with other dimensions shown for the new German locomotives as though it were a factor to which we have always been accustomed? Don't you think that if feed water heaters are a success in Germany we ought to make a success of them in this country?

There seems to be a general impression that the Latin-American countries are behind the times, but you will probably reach a different conclusion after reading the article on South America by Mr. Risque. In this issue he tells of some interesting methods used to overcome difficult operating conditions in the Andes.

Even though you are not an air brake expert, you will want to study the report of the Air Brake convention. The paper on the steam consumption of locomotive auxiliaries is particularly important, as it shows a serious source of fuel waste that is often overlooked.

The author of the story "How the Master Mechanic Increased Production," has some unusual ideas about handling men which every foreman or executive should consider carefully.

In conclusion, don't neglect the comments on articles published in previous issues which are found on the next four pages. They represent the views of men who are right on the firing line and may give you a new viewpoint on some important questions.

COMMUNICATIONS

EDITORIAL ON SERVICE OF SUPPLY DRAWS FIRE

TO THE EDITOR:

I have a copy of the *Railway Mechanical Engineer* for May, 1920, and have read the editorial on page 256 entitled Service of Supply.

I do not think you have handled this on a broad enough basis; you admit that delays for material offer one of the best excuses for not getting power out, and later state that the supply department can usually produce a convincing argument as to savings made by reduction in material cost, which the shop superintendent cannot prove in dollars and cents. There is no room for argument as regards the desirability of having the very thing you need at your disposal at all times, but if this theory were to be put into practice, nine-tenths of our business institutions, as well as our railroads, would be in receivership. Such a proposition is not justified, except in case of war, and it is open to criticism even then.

Business must be conducted on the basis of its credit; if it spends more than its receipts and has not sufficient capital at its back to carry it through, it is insolvent. A railroad's operation must necessarily be based on its earnings, plus its borrowing power. Materials use approximately 35 per cent of a railroad's gross earnings; therefore, a railroad's expenditures must be guided largely by its earnings. Labor is fixed by law; the only savings that can be made in materials is its better utilization.

The problem of supply is one that embraces not only the demands, but is one of finance; every dollar tied up in material is unliquid capital and bears the regular interest rate, plus deterioration and obsolescence. Shop superintendents and shop foremen are interested only in their particular work and have no conception of the problem of supply, taking in, as it must, the entire requirements of the railroad.

A railway may need double tracking, passing tracks, yard facilities, round houses, shop extensions, shop tools, and many other things, but that is not given as an excuse for not moving trains, or even moving them economically. *The real measure of an organization or individual is what they are able to accomplish with the facilities at their command.* One may see locomotives and cars by the scores lying over for months for repairs, and at the same time hear the cry of work being delayed for material. There is no such thing as work on a railroad being delayed for material; there may be some particular work delayed for material, but there is always more work on a railroad than there is money or men to do, so that the losses experienced by lack of material are largely a myth on most of our railroads and in practically all of our shops.

Nothing in the above is to be construed as justifying the lack of sufficient material to protect the operations of the railroad; that is vital, but it can be set down as a fact, that the railroad that has the most material, has the least material available. The best operated railroads are the ones that have the least money tied up in materials, and an organization which is capable of meeting emergencies and utilizing everything they have to the best advantage.

GENERAL PURCHASING AGENT.

HANDHOLES VS. WASHOUT PLUGS

GREAT FALLS, Mont.

TO THE EDITOR:

I have read with much interest the article by Mr. Lipetz on above subject in your April issue. If we adopted handholes on our locomotives, as used in Russia, they would be the source of much trouble and worry to our mechanical departments.

While Mr. Lipetz's argument in regard to safety might be true, yet accidents that happen in this country from washout plugs blowing out can usually be traced to carelessness on the part of the boiler washer, either in leaving a loose plug, or putting the plug in cross threaded.

I have just returned from Siberia after over two years' experience on the railroads there, and have seen considerable of the type of handholes described. The new American Decapods in that country are all equipped with these handholes; it is surely anything but ornamental to see the "horse shoe" clamps used on this device sticking out around side sheets and throat sheets. Boiler washers have to exercise great care in replacing the lead gaskets—have to feel inside to see that the seats are properly cleaned before replacing the cover, which process consumes much time.

I have also seen not a little trouble due to leakage, and when that happens in a country where bad water is practically unknown, what might happen in our bad water districts here where we get such an accumulation of scale and dirt. I am afraid the seats would be a continual source of trouble. Mechanical men are quite familiar with the troubles that our belly plate gaskets give and I don't believe they want more gaskets on the boiler. The initial expense of application is heavy compared to washout plugs, also the expense of continually renewing the gaskets.

It would be a step backward to replace washout plugs with handholes.

JAMES GRANT,
Great Northern Railway.

WOMAN IN RAILWAY SHOPS

BILLERICA, Mass.

TO THE EDITOR:

During the war, many women were employed in railway shops not only as clerks, sweepers and cleaners, but as machine operators in the tool rooms and machine departments. A long enough period has now elapsed to get a perspective of the results accomplished by this introduction of women into railway work and what the possibilities may be for the future. Most of the shop managements replaced their women employees with men as fast as the latter became available after the armistice was signed and men only are now employed. In some shops, however, women have been retained as sweepers and, in a few cases, operate machines such as lathes, shapers, milling machines, etc. The total number of women employees retained for shop work, however, is very small and it is doubtful if their number will ever be materially increased except in case of another emergency.

An analysis of the motives causing women to enter the railway shop service, shows why so small a number kept their positions after the war was over. In some cases, women took up the work to help support their families while the

men were in the military service. In other cases, the work was undertaken because a desire for notoriety and the opportunity to meet men. In still other cases, the principal motive was a liking for machinery and mechanical work.

Women who entered railway service for either of the two first motives could be classed as temporary employees and would remain only until they were married or the head of the family returned. The latter class, however, included a few women who became very efficient and skillful machine operators. They attended strictly to business, wasted no time and were more quick and dexterous than men in operating the lighter machines. These women were most welcome in any machine shop but, unfortunately, they formed such a small minority of the total number as to be practically negligible. On the road with which I am familiar only two out of several women employees developed into really skillful machine operators.

FOREMAN.

SPECIFICATIONS FOR SOFT METAL BEARINGS

WASHINGTON, D. C.

TO THE EDITOR:

With reference to the article on soft metal bearings appearing in the May issue of the *Railway Mechanical Engineer* and your editorial on page 256 of the same issue. The first part of the article by Mr. Frank is an excellent presentation of the general principles of bearing metals.

The article next mentions the specifications of the American Society for Testing Materials. The committee which prepared them included railroad representation. The three bronzes specified are approximately similar to three of those specified by the American Railroad Association and the Railroad Administration. The assignment of two of these alloys to specific bearings is peculiarly different, however. The two last mentioned organizations use a harder metal for locomotive driving bearings than for car bearings, while the A.S.T.M. reverses this arrangement. From the standpoint of cool running (the most important feature of the operation of bearings) either alloy may ordinarily be used for either purpose. The driving bearings are, however, subjected to greater shocks, therefore from this standpoint should be of the harder metal. It is to be understood that the term is only relative. Both alloys are softer than the No. 1 bronze.

The reader of Mr. Frank's article may possibly gain a partially erroneous idea of the Railroad Administration specifications used for car and locomotive bearings during the war. They were not new ones. They were essentially the existing standards of the Master Car Builders' and Master Mechanics' Associations. The only changes made in the bronze were (1), a reduction in the minimum phosphorus in phosphor bronze for locomotives, from 0.7 to 0.4, on account of the scarcity of phosphorus, and (2) an increase in the maximum impurities in locomotive bronze to two per cent. (Before the U. S. R. A. specifications could be issued, a part of the locomotive hard bronze was ordered without phosphorus.)

The four U. S. R. A. bronzes were therefore as follows:

		Locomotive Bearings		
	Car Bearings	Phosphor Bronze	Medium Bronze	Soft Bronze
Copper, max	.....	82	77	65
Copper, min.	65	....	....	.....
Tin, min.	4	8	7	4
Lead	24-30	8-13	14-20	20-33
Phosphorus	.....	0.4-1.0	0.2-0.6	.....
Impurities, max.	3	2	2	2

The car bearings were the largest item. Without stopping to make an accurate survey, it is safe to say that the average composition of the bearings actually furnished was much nearer 24 per cent lead, the minimum limit than 30 per cent, the maximum. The soft bronze was used only for hub liners and constituted only a small percentage of the total requirements for bearings. The composition, 65 copper, 5 tin, and 30 lead, can therefore hardly be called typical or average. The average lead would be much lower.

It is generally considered that the lead is the "anti-friction" constituent of the alloy and should be as high as possible, consistent with sufficient strength of the bearing and satisfactory foundry work.

It is agreed that temperature of pouring both bronze and lining metal is very important.

The writer does not agree that "little can be expected, at present, from inspection tests." Chemical composition within proper limits, with respect to both the essential constituents as well as the individual impurities, must be secured, and can be determined fully only by analysis. The other important detail in inspection is the surface appearance and the fineness and uniformity of grain and the soundness and homogeneity of the metal as shown by the fracture. In the hands of an experienced inspector these give much information on the conditions of manufacture. Microscopic examination is very useful in special investigations. Compression tests are not generally employed in routine inspections except for bearings carrying very high pressures.

H. E. SMITH,

Engineer of Tests, New York Central Lines, West (Asst. Manager Inspection and Test Section U. S. R. R. Administration).

I. A. LEARNS SOME THINGS ABOUT "PASSING THE BUCK"

TO THE EDITOR:

While at Westport, become necessary learn why dirty gage glasses not replaced. Hon. M.M. agree are not done because Stkpr. do not furnish. Sustain M.M. veracity, becomes bounden duty interview aforesaid Stkpr.

In pursuit of elusive person, Jap Detector at end directed clean cut young man in blue overall suit, and blue shirt with soft collar, who are bossing unloading gang. Sympathy are elicited by distressed appearance and learn he are helpless victim of Wage Board and U.S.R.R.A. "pass the buck."

Indicating Hon. self, he declaim that it are impossible eat, live and clothe on large salary Stkpr. U.S.R.R.A. have looked out for ash-pit shoveler, Bolsheviki, shop cobblers, all but Stkpr. Result he are responsible for keeping down R.R. H.C.L., but so busy making $1 buy $2 pork and beans, potatoes and other necessities keep body and soul, Hon. self and family, he are distraught.

G. F. who run back shop with help S. S. are laden with 275 iron men per month while Stkpr charged with $5,000,000 stock each year get 210 and storehouse foreman 115. Surprising intelligence are Hon. Stkpr in blue overalls. With majestic sweep of hand he declaim, other Stkpr's get $150, some $175.

Jap detector become further initiated in mysteries forbidden storehouse and find paper pins, also engine fireboxes in yard. Impressed by magnitude Stkpr job. Advised impossible keep man, when road contractor bid high, also industry in town, which account for fact he are overlook unloading when Jap Detector discover him.

Breast filled with pity for distressed Stkpr; hesitate. It are bounden duty as Imperial Government detector to learn why gage glasses not forth coming. Assume commanding attitude and demand explanation, beating down rising pity. Stkpr. tearfull admit such *are* true, but he are crushed struggling with H.C.L. and problem beans. Storehouse Foreman have succumbed to struggle with 115 iron men. Chief Clerk have gone digging ditches account need clothes to cover naked form. Load of Stkpr. so heavy impossible carry. Result no gage glasses ordered until G.F. and Hon. M.M. announce glasses assume zero. Some time G.F. announce twelve year boy can run Storehouse better Stkpr. Stkpr. reply he are d—m well cognisant truth stated, but G.F. job insignificant

alongside Stkpr. job, and he had two year boy make better G.F. than present incumbrance.

Stkpr. express great sorrow lack gage glasses and conclude "if Gage Glasses are so long come as promised wage boost, engine worn out when arrive." INO AMSURA.

THE SHOP WAGE AGREEMENT

NEW YORK.

TO THE EDITOR:

I am greatly interested in the invitation under "What Do You Think?" on page 191 of your April issue, to comment on Mr. McManamy's article in that issue on the Shop Agreement.

The shop committee idea was suggested by the Railroad Administration during the last few months of federal control and a number of the roads appointed such committees. Something might have been accomplished if the matter had been handled in the proper way. The difficulty lay in the manner in which the instructions were issued; i. e., to have the members selected by the regular shop committeemen. This, coupled to conditions that existed in the shops at the time, made the realizing of any good results very problematical.

Supplement No. 4 to General Order No. 27 was the first milestone and probably the worst one of the many things that were wished on us and which resulted in the tearing down of the structure of our organization. This placed all our mechanics—good, bad, and indifferent—on the same footing; prohibited rewarding merit in any manner; made our better mechanics dissatisfied in that they received the same wage as the incompetent workers; and in the cases of men who were working before as handymen and who were given full rated mechanics' pay under the application of this order, their status was in no wise improved—they were practically spoiled by receiving large sums as back pay.

Our former method of handling these handymen was surely much the best; they were advanced on the grade of work and in pay as they were worthy of advancement and in the course of time were promoted to full rated mechanics. This method gave the foreman an excellent opportunity to gain the workman's loyalty and co-operation,, as the foreman in all cases was required to recommend and approve those selected for promotion. In fact the application of Supplement No. 4 took away from the supervisors almost entirely having anything to say as to wage, making the situation most difficult.

In the Eastern district where the demand for skilled mechanics has been so urgent during the last three or four years and the railroad wage rates considerably under those paid on the outside, the foreman already had his hands full trying to prosecute work through the shops with a large per cent of poorly skilled help. Loading him up with an instrument embodying all the hide-bound union conditions found in Supplement No. 4 certainly could not improve conditions and went a long way to increase the already burdensome and inefficient conditions.

The next important move was the order that no mechanics could be employed after July 25, 1918, without having had four years' experience as a mechanic. Many of us were compelled during the war to employ men with less than this amount of experience; they were put on as step-rate men. The road had to be kept going; men of long experience could not be obtained. After considerable time had elapsed all these men employed after July 25, 1918, were advanced to the full rate and given large back pay sums. This made our older men in point of service very much dissatisfied and unsettled and materially helped along the growing undesirable conditions. While these men were either reduced to helpers or helper apprentices, under this order, the rest of the men felt that they were not entitled to the back pay, and took the attitude that they should not have been employed in spite of the fact that we were forced to do so during the war period, these very same men claiming that they were intensely patriotic and yet it was impossible to get them to speed up their production.

The shopmen utterly failed in selecting the best from among themselves as their union officers and committeemen; men with absolutely no judgment or balance were selected in many instances. In some cases they were men who could not intelligently read an order and properly construe it. In some instances they gave out wrong interpretations to the members which resulted in many complex situations and much dissatisfaction. Many men were wrongly influenced so that they developed a grudge against the company. It was a foregone conclusion that committeemen selected for the shop committee by the regular union committee would not be the kind of men that would make up a committee worth while—one that would assist the men in charge of the shops in bettering conditions.

As to the National Agreement; while it is possible that there were some benefits derived from this agreement in certain districts in that it made conditions uniform, results generally were not the best. There are many rules in this agreement that unquestionably helped along our already burdensome conditions. Absolutely no differential rates whatever were allowed to the men in the machinist craft. The blacksmith and boilermakers were given differential rates for practically all the men who do the better class of work; the machinists as a result were much disturbed. The old axiom of treating all men fair and square seemed to be farthest removed from the intentions of many of the orders that were issued.

The rule requiring two mechanics operating a long stroke hammer capable of driving ⅝-inch rivets or staybolts, or larger, was surely unnecessary. Two men cannot possibly work on a hammer driving staybolts. Also the rule requiring that sufficient help be furnished mechanics operating compound motors; our men tapping staybolt holes have for years done this work with a light one-man motor with no hardships whatever.

GENERAL FOREMAN.

INCREASED MILEAGE FROM ASSIGNED ENGINES

TAUNTON, Mass.

TO THE EDITOR:

The return of one of the heavy passenger locomotives to the repair shops of one of our eastern roads, after having handled one of the crack limited trains on that road for over a year between shopping and making a total of about 115,000 miles, when other locomotives of the same class cannot show an equal performance, gives rise to an interesting situation.

It seems, however, that this locomotive in question is handled by two engineers, on different days, of course, and the writer believes that this case and other citations to follow will go far to prove that the best way and the most economical way is to give a man an engine and let him keep it.

Another instance. On a certain eastern run of 57 miles, the death of the engineer caused a new man to be placed on this run. Several men and several locomotives were tried and finally a suitable locomotive was placed on this run, but the men had trouble handling the locomotive, and about every other trip a visit to the repair shops was necessary. About the first of March a certain careful engineer was placed on this run, and a man who was interested in his machine. The result has been that since that date this locomotive has not missed a trip, nor can one minute's delay be charged up to this locomotive. This engineer has this locomotive all the time and no other.

A certain north and south line in the Middle Atlantic

States has adopted this policy of assigning a locomotive to an engineer and with admirable results. I believe that one of our eastern trunk lines on its two most famous and fast trains uses this same policy.

Very well. If our railroad managers find it a wise policy to adopt this scheme for their fast runs, why not carry it a step farther and make it universal, at least for passenger trains. There no doubt would be too many difficulties to overcome in freight service.

Anyone who has overheard a group of enginemen talk after having completed their runs might well draw a conclusion that there was not a single locomotive on the road fit for service. Can you blame them? Any man who has to run about a half a dozen different locomotives in as many days is going to lose interest in his machine. What does he care if someone else is going to have her on the next trip? Give a man a rickety engine, and you will have a rickety engineer. Assign him a certain machine, let him study it, know the "kinks," what she will and what she won't do, and your runner will be making his schedules and saving money in the long end, and the average man, unless he is a hog, will take care of his machine—it is human nature to do so.

The old excuse will be that "It can't be done." It can be done if the managers are so minded. Another excuse—"the locomotive mileage will be reduced." Doubtless it will be *per month*, but how about it in the long run, say 12 or 18 months? Every time a locomotive goes into the shops for a thorough overhauling, it costs money, and the railroad is deprived of earning money from that locomotive every day it is in the shops, and this holds true when the locomotives undergo slight repairs, and in these days of high labor and material costs this item seems worthy of attention.

If a locomotive, assigned to one of our fast limited trains, in charge of two careful men, alternately, can produce 20 per cent more mileage between shopping, then figure out the proportionate reduction of shop charges and increase in train mileage, were every other locomotive of this class thus treated. Is it worth it? I think so!

Chas. E. Fisher.

INFLATED TONNAGE RATINGS

Cleveland, Ohio.

To the Editor:

Mr. Mounce's article on practical freight train loading, which appeared in the May issue of the *Railway Mechanical Engineer*, is a very able presentation of the main problems involved in determining the tonnage that can be most expeditiously and economically handled. The article is in fact a very clear exposition of the principles involved and it would be difficult to take exception to the figures submitted by Mr. Mounce except from the standpoint of the practical means by which it is proposed to arrive at the desired results.

I have in mind particularly the effect which an inflated tonnage rating will have on the engine and train crews hauling these trains. It is well known that a great many locomotive engineers are governed in handling trains very largely by the tonnage which they are told that they are hauling. It is not always possible to explain to these men the significance of adjusted tonnage ratings and that a rating which takes into consideration a car factor added to every car in the train is to a certain extent fictitious.

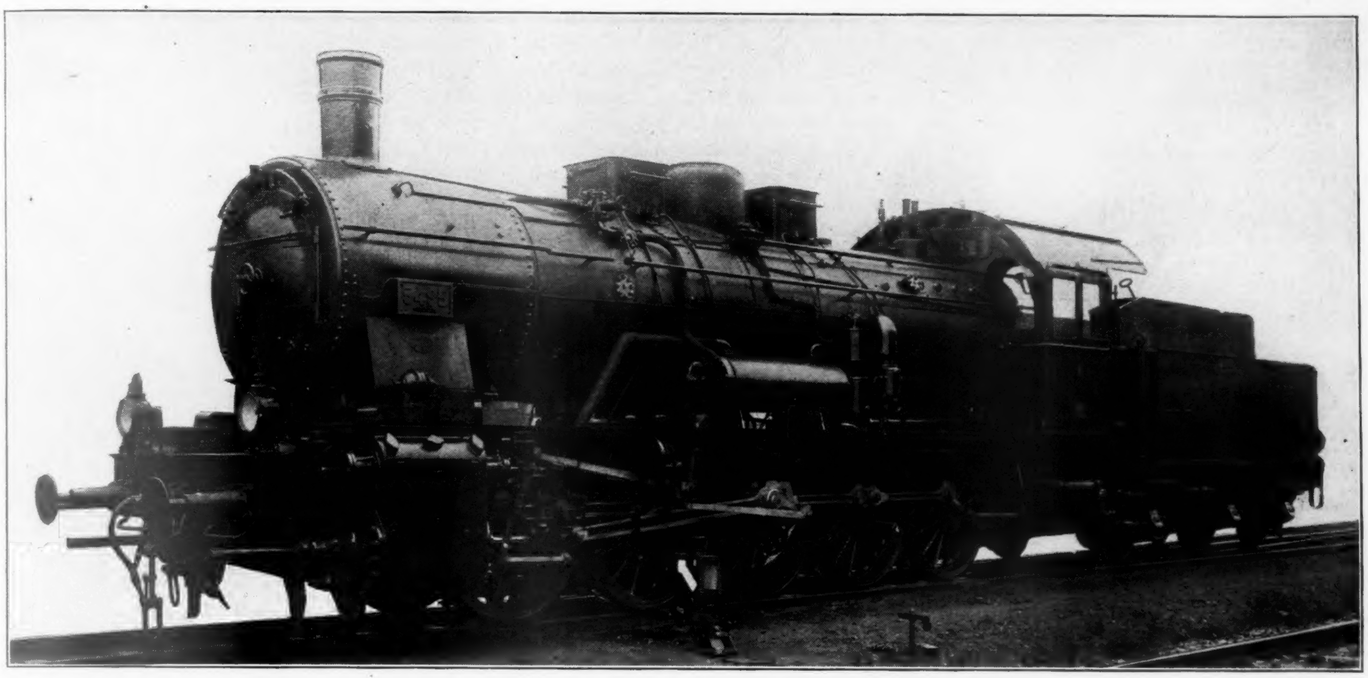
If a car factor is added to the weight of every car in the train in an attempt to equalize the variable resistance of cars of different weights, the result is an apparent tonnage always in excess of the actual tonnage. The result of this is that the apparent difference in tonnage between trains consisting entirely of heavily loaded cars and trains comprising only empty cars is exaggerated and we have what might be termed an inflated tonnage rating. This does not affect the scientific correctness with which the train is loaded, but it manifestly affects the psychological effect on the locomotive engineer who is hauling the train. This psychological effect may not be confined to the locomotive engineer, but may have an equally potent effect on the division superintendent who has not taken the pains to reason out the theory of adjusted ratings nor to carefully study their effect. The fact that the average tonnage per train handled over his division actually averaged considerably less than the average adjusted rating assigned to the division may have a very dampening effect on his enthusiasm for making a good tonnage showing.

We have to depend so much on paper or statistical showings to obtain results in modern railroading that it is well to respect any method that will sustain interest in making a good showing and discourage any procedure that tends to break down a favorable report even if the underlying motive is sound. Therefore, while it is highly important that all tonnage ratings be adjusted, it is equally important that any method employed, for securing these adjustments be such that the average car factor be as small as possible. The same ultimate loading, for instance, may be obtained by adding a certain car factor to every car in the train, dependent on its weight, as by adding a much smaller factor to some cars in the train and subtracting a factor from other cars. In the latter case it is obvious that the total adjusted rating of the train will be a much lower figure than in the first case, although the actual weight of the train will be the same. In fact, if the average weight of all freight cars to be handled were approximately the same and this weight were known, the adjusted rating could be made to equal the actual rating, or if this were a permanent condition there would be no necessity for adjusted ratings.

The point is that in determining adjusted ratings for any freight division, an attempt should be made to determine the approximate average weight of cars usually handled over the division in each direction. This weight then should be adopted as, what might be termed, the neutral weight and all car factors to be employed in the adjusted rating should be based on this weight. To all cars below this so-called neutral weight a car factor should be added, increasing in amount as the weight of the car diminished; while from all cars exceeding this neutral weight a proportionate car factor should be subtracted. Unless there is great variation in average weights of cars handled in a single direction over a certain division the adjusted rating can be determined in the manner above outlined, so that the adjusted rating assigned to freight trains will not vary greatly from the actual weight of these trains. The actual weight of trains and the total tonnage hauled over a division will theoretically be no greater with adjusted ratings corrected so as to approximate actual tonnage than with adjusted ratings computed in the manner outlined by Mr. Mounce, but the practical results obtained from a tonnage standpoint will be much improved, due to the fact that there is a much better understanding among all concerned in the movement of trains as to the actual tonnage handled by each train.

Under the arrangement outlined by Mr. Mounce it may happen that the adjusted tonnage where principally empty cars are being handled is 500 tons in excess of the actual tonnage. If this adjusted tonnage were corrected on the basis of the average weight of cars handled, which in this case would take into consideration the preponderance of empty cars moved, it would probably not vary more than one hundred tons from the actual tonnage. Practical men know the great value of having a system that does not confuse those to whom its execution is entrusted. The adjusted tonnage rating should conform to this rule and while retaining all the advantages to be secured from the equalization of car resistances must be exceedingly simple in its application and should not involve results which are not clearly understood by all concerned in its application.

L. Greenleaf.



Superheater Freight Locomotives of the G-10 Type for the Prussian-Hessian Railway. The First Locomotive Built by Krupps.

The Railway Situation in Germany

Shortage of Locomotives the Limiting Factor. Output of Labor Greatly Decreased

BY ROBERT E. THAYER
European Editor of the Railway Mechanical Engineer

THE aftermath of the war in Germany has been much more severe than perhaps was anticipated at the end of the war. The new government, formed after the revolution, was made up of men of little experience in the governing of a nation the size of Germany and as a result there has been a constant state of unrest, dissatisfaction and no co-ordination of effort. With the bolshevistic seed fairly well germinated, it was doubly hard to get the nation back on a peace time rating. It has been the labor situation that has delayed the recuperation of this country. Not only has this been felt in the industries but on the railways.

Part of a Mixed Train on German Railway

Whereas before and during the war and up to the year 1917, the German railways earned sufficient revenue to pay a dividend to the state, the cost of materials and wages increased to such an extent in 1918 that there was a deficit of 3,800,000,000 marks, and in 1919, this rose to 4,600,000,000 marks. For 1920, it is anticipated that the figures will be considerably higher than this, for during that year some 2,000,000,000 marks were added to the railway pay roll. In order to meet this added expenditure, the rates up to the present time have been increased 600 per cent for freight and 700 per cent for passengers as compared with the pre-war rates.

Serious Lack of Available Power

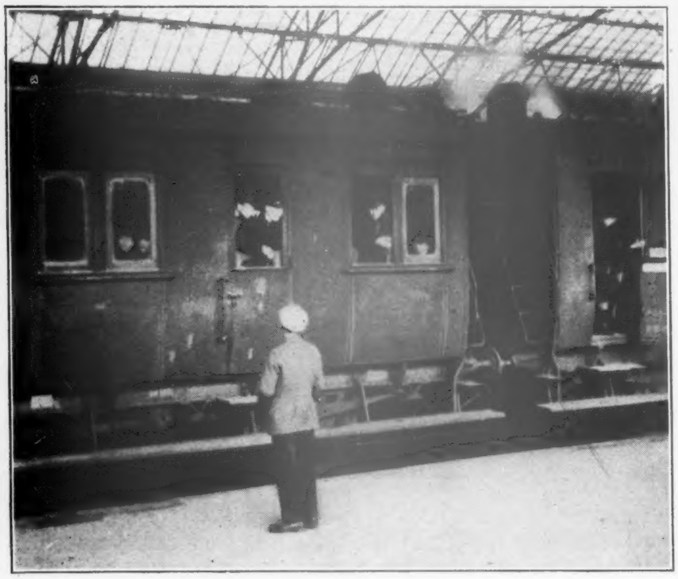
One of the greatest difficulties the German roads are experiencing today, is the lack of adequate locomotives. Notwithstanding the fact that Germany has a greater number of locomotives now than it had at the beginning of the war, it has been unable to keep them in repair on account of the extremely poor labor conditions. The low morale of the shop forces is almost unbelievable. It has been authoritatively stated that the output has decreased to from between 20 to 30 per cent of the pre-war output and at the same time wages have been increased from four to five times. Conditions were so bad during the early part of this winter, that it was found necessary to close some of the shops absolutely for a few weeks in order to teach the men a lesson. These shops were then reopened, each man being employed being required to work under conditions laid down by the railway shop managers. In some instances it was found that the men in the pattern shops were spending their time making toys which they sold later on the streets.

At the same time, due to the Peace Treaty, the German roads have lost 12 or about 16 per cent of their main repair shops and 3, or 23 per cent of their secondary repair shops. The conditions were so bad that in order to maintain any semblance of railway service repairs had to be put out on

contract to various industries that were in a position to handle such work. The equipment builders were requisitioned to take on repair work. Krupp's plant has repaired some 300 locomotives and has between 100 and 200 on hand for repair. The shipbuilders principally took on this work as the construction of ships has practically been brought to a standstill. The North German Lloyd is making a specialty of repairing cars and has handled some locomotive repairs.

Condition of Passenger Cars

The passenger equipment which is in operation may be said to be in good running condition, but its finish and upkeep is deplorable. The cars are dirty inside and out, there is practically no covering on any of the seats and the passengers have to be content to ride on cushions of dirty buckram which has become shiny with use. Many of the windows, which are of the drop sash type commonly used on the Continental roads, are in an inoperative condition due to the fact that the leather straps by which they are operated have been removed. This condition has been caused by the fact



Crowded Fourth Class Cars in Germany

that the seat coverings and the leather straps were cut away by passengers riding in the cars or thieves in the car yards, as there was a serious shortage of all leather and cloth goods.

Increase in Number of Locomotives Owned

While it is impossible to obtain detailed figures regarding the condition of locomotives for all of the German railways, the condition on the Prussian-Hessian system may be taken

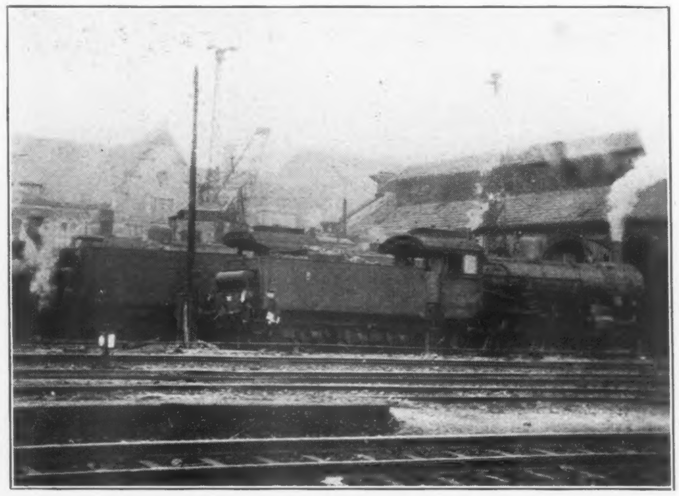
LOCOMOTIVES ON THE PRUSSIAN-HESSIAN SYSTEM

Date	Locomotives owned	Percentage in bad order
1910	19,670	...
1911	20,187	...
1912	20,758	...
Aug. 1, 1914	21,882	19.5
Nov. 1, 1918	27,991	33.5
Mar. 30, 1919	22,538*	43.2
Sept. 3, 1919	23,248	44.6
Jan. 15, 1920	23,956	47.2
Feb. 12, 1920	23,224**	46.2

*After locomotives were delivered to the Allies.
**After locomotives were delivered to Poland.
Note—Germany has still to deliver to the Allies under the terms of the armistice, 280 locomotives and 2,000 cars. The Prussian railways now have on order some 1,500 locomotives.

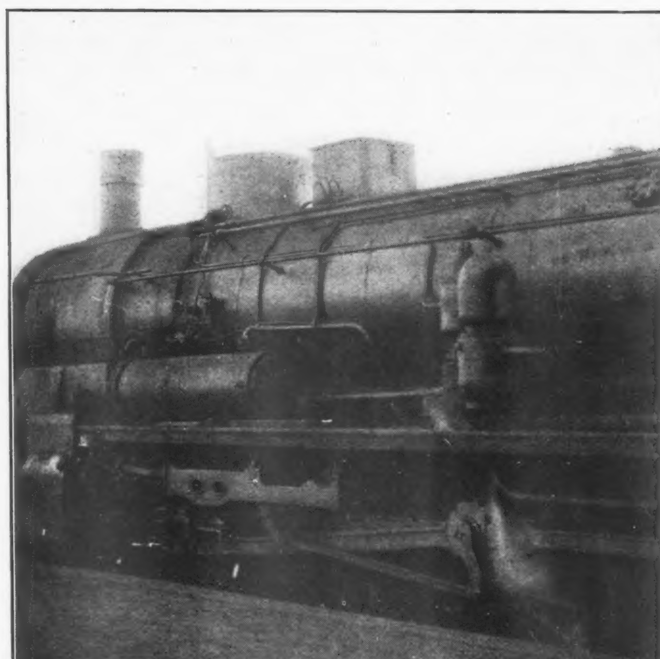
as indicative of the entire country. This system owns about 81 per cent of all the locomotives in Germany and on January 15 of this year over 47 per cent of its locomotives were out of service for repairs. In view of the further disturbances that have risen in Germany, this figure has probably increased to over 50 per cent at the present time. Table I will show for the Prussian-Hessian system how the percentage of locomotives in bad order has increased.

This table also shows the increase in the number of locomotives on the Prussian-Hessian system from 1910 to February 12, of this year. It will be seen that before the armistice was signed (November 1, 1918) the Prussian system



Engine Storage Shed at Dusseldorf

had 27,991 locomotives as compared with 21,882 at the beginning of the war—an increase of 6,109. For all the roads in Germany the increase in locomotives owned was 6,648 (about 24 per cent) or a total of 34,570 on November 1, 1918. Of the locomotives turned over to the Allies under the terms of the armistice the Prussian system furnished about 83 per cent and this accounts for the drop between



Locomotive Equipped With Feedwater Heater

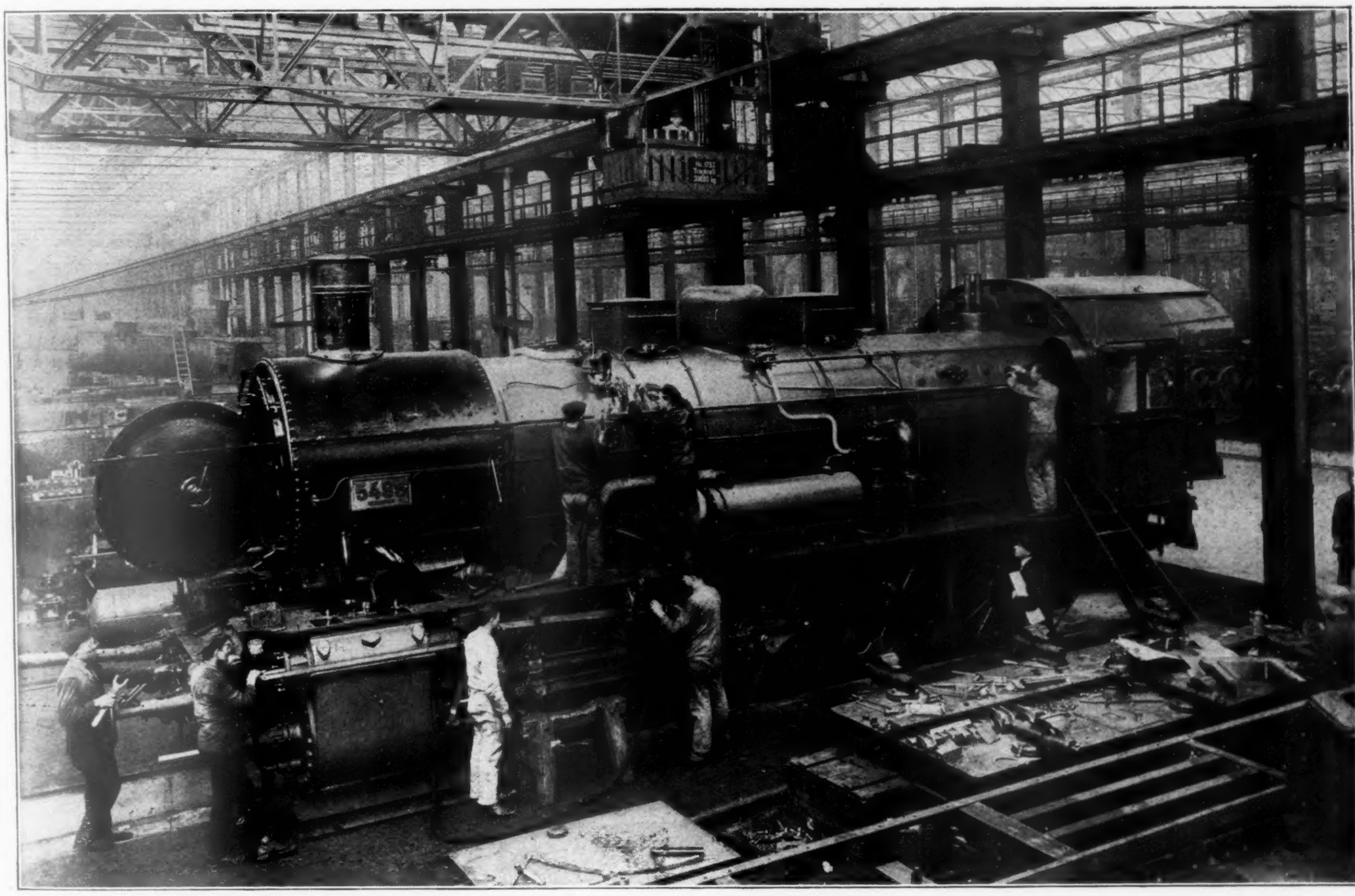
November 1, 1918, and March 30, 1919. There is a further drop between January 15 and February 12 of this year, of some 734 locomotives which is accounted for by the fact that at that time Germany was required to turn over a large number of locomotives to Poland.

The fact that Germany has more locomotives today than

she had before the war, regardless of the fact that she had already turned over 5,000 locomotives to the Allies, is accounted for by the intense locomotive production during the war. The locomotive manufacturing plants were called upon to do nothing else but build locomotives. Each plant was given a specific design to build and they turned them out in large numbers. It has been stated that during the war the number of locomotives built for the Prussian-Hessian system since 1913 averaged from 1,200 to 1,500 per year. Practically all of these locomotives were of a heavy type—for Germany—and of the most improved design.

New German Locomotives

Two of the latest designs built for the Prussian State are of the 2-8-0 and the 2-10-0 types, their principal dimensions being shown in the accompanying table. Both of these engines have three cylinders. The inside cylinder is inclined and all three drive on the third axle. The right-hand driving crank follows the left at an angle of 120 deg. and the inside driving crank forms an angle of 152 deg. 21 min. with the right-hand outside crank and an angle of 107 deg. 39 min. with the left. These engines are equipped with the Schmidt superheater, brick arches and feed-water heaters. From trial performances it is found that the 2-8-0 locomotives were capable of hauling, on the level, 1,150 long tons at a speed of 40 m.p.h. while the 2-10-0 type was able to handle 1,400 long tons at the same speed. It is interesting to note that these engines are not compound and as a matter of fact with the present degree of refinement in superheating and feed-water heating, the engineers of the Prussian-Hessian have given up the idea of building any more compound locomotives.



Erecting Shop at Krupps

PRINCIPAL DIMENSIONS OF NEW GERMAN LOCOMOTIVES

	2-8-0 Type	2-10-0 type
Service	Freight	Freight
Gage	4 ft. 8½ in.	4 ft. 8½ in.
Weight in working order	179,000 lb.	205,000 lb.
Weight on drivers	150,000 lb.	176,000 lb.
Weight per axle	37,500 lb.	35,200 lb.
Wheel base, driving	14 ft. 9 in.	19 ft. 8 in.
Total wheel base	23 ft.	27 ft. 11 in.
Cylinders, number	Three	Three
Cylinders, diameter and stroke	20½ in. x 26 in.	22½ in. x 26 in.
Valves	Piston	Piston
Drivers, diameters	55 in.	55 in.
Boiler	Belpaire	Belpaire
Working pressure	206 lb.	206 lb.
Tubes, number and diameter	189, 1¾ in.	189, 1¾ in.
Flues, number and diameter	34, 5 in.	34, 5 in.
Length of flues	13 ft. 5 in.	15 ft. 9 in.
Heating surface, tubes and flues	1,662 sq. ft.	1,947 sq. ft.
Heating surface, firebox	135 sq. ft.	153 sq. ft.
Heating surface, total	1,797 sq. ft.	2,100 sq. ft.
Superheating surface	629 sq. ft.	736 sq. ft.
Feed water heater surface	146 sq. ft.	146 sq. ft.
Grate area	37 sq. ft.	42 sq. ft.

Modernizing Railway Equipment

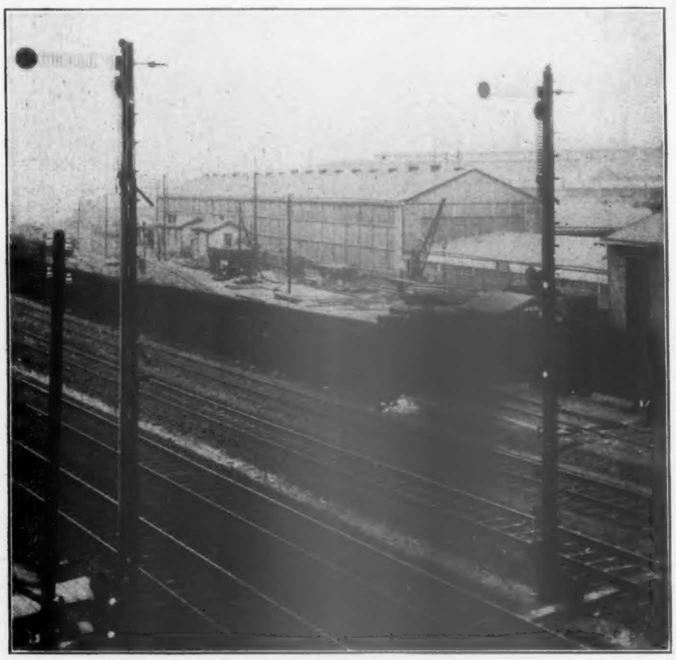
The coal situation in Germany has been disastrous to the railways as it has been to all of the other industries. It has always been the desire of the German railways to keep a three months' supply of coal in storage but at the present time it is difficult to get a supply for more than three or four days. Whereas in December, 1913, the Prussian-Hessian system held an average of 3,000,000 tons on hand, in February, 1920, the supply was only 100,000 tons which was hardly sufficient to last three days. In addition to the lack of it, coal has been of a very inferior quality and whereas the standard consumption was about 15 tons per 1,000 locomotive-kilometers it is now between 20 and 25 tons. Due to the severe shortage of lubricating oils, it has been necessary to extract the coal tar products of the coal which has thrown a large amount of coke on the railways for locomotive use.

Large Numbers of Feed Water Heaters Applied.—As in everything else, the price of coal has greatly increased. Be-

fore the war it was purchased for 12.5 marks per ton, but the railroads now have to pay 200 marks per ton. It will thus be seen that the increased cost of fuel has been a great factor in the increased operating costs. In view of this situation every attempt has been made to increase the efficiency of the locomotives. One means of doing this is by the application of feedwater heaters to all new locomotives with a plan in progress of applying them to all existing locomotives regardless of type or service. The success the German railways have had with the use of feedwater heaters has warranted this development. Whereas the thermal efficiency obtained is between 10 and 12 per cent there is a claim for an overall economy from 20 to 25 per cent.

This feedwater heater is known as the Knorr heater. It is of the tubular type taking exhaust steam from the cylinders and auxiliaries. The feedwater is forced through it by a pump located between the heater and the tank, which thus keeps the heater under boiler pressure. It has been estimated that these heaters will more than pay for themselves in the economy they produce under the present price of fuel within one year.

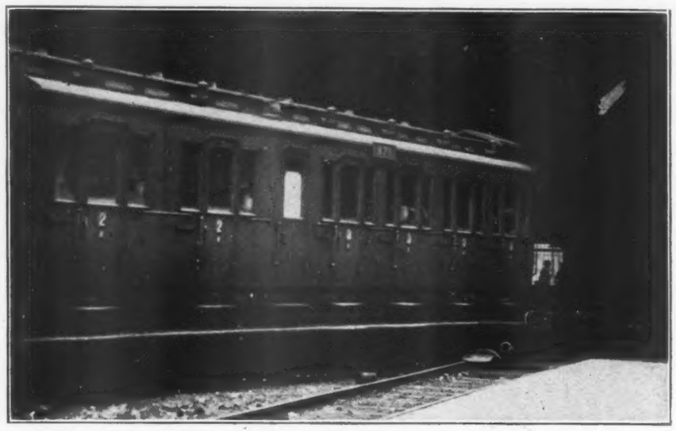
Freight Cars to be Equipped With Compressed Air Brakes.—As indicated by the manner in which the German railways



Railway Entrance to Krupps Plant at Essen

are applying feedwater heaters to their locomotives, the officers are not hesitating to spend money in order to save money regardless of the fact that the roads are now being operated under such heavy deficits. In addition to improving the locomotives a very extensive program is being carried out in equipping the freight cars with Kunse-Knorr automatic air brakes. This is a compressed air brake which is standard on the Prussian system. A program involving the expenditure of 260,000,000 marks for this purpose has been started. One-third of the existing cars on the Prussian system, or about 175,000 cars, have been equipped with this brake and all new cars will be. By 1927 it is planned to have all freight cars on the Prussian system equipped. It has been estimated that at the end of 10 years a saving of 60,000,000 marks will be obtained, after having paid for the cost of the installation, as a result of the saving in wages of the train crews alone. This brake is of a relatively new design and operates on a principle similar to the Westinghouse brake.

The Continental roads before the war endeavored to come to some arrangement for the application of a standard brake to all freight cars in order to facilitate the interchange of traffic. The problem at that time was whether the vacuum or compressed air brake should be used. Strangely enough the strongest advocates of the vacuum brake were to be found in Austria and even during the war, tests and negotiations were carried on between Austrian and the German roads in an attempt to settle the matter between them, but the unsatisfactory closing of the war to those countries prevented an agreement being reached. It appears by this extensive ap-



Passenger Car on Turntable Lead in the Station at Dusseldorf

plication of the power brakes to the Prussian roads, an attempt is being made to force the compressed air brake on all other nations in central Europe if they want to participate in the exchange of equipment with the German lines. While the use of automatic couplers is greatly desired to replace the screw couplings on freight cars, plans have not been developed sufficiently to permit of any definite action in this respect.

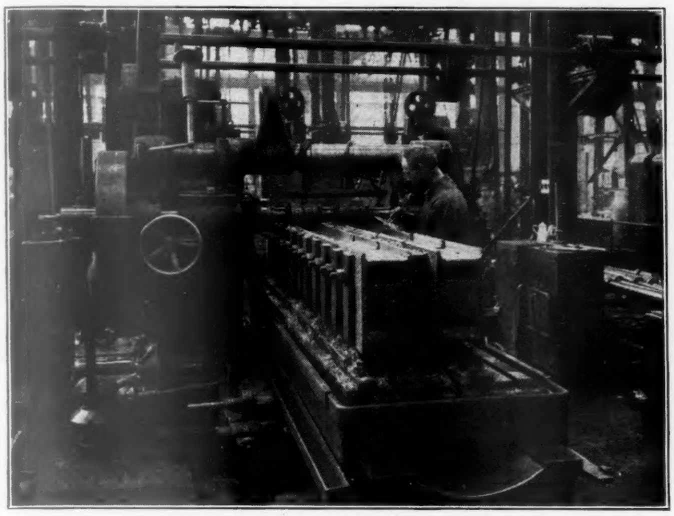
Car and Locomotive Building by Krupps

During the war the munition plants in Germany were developed and extended to a great degree and on the return to peace conditions these plants have been seeking to reconstruct and adapt their facilities to peace-time pursuits. The

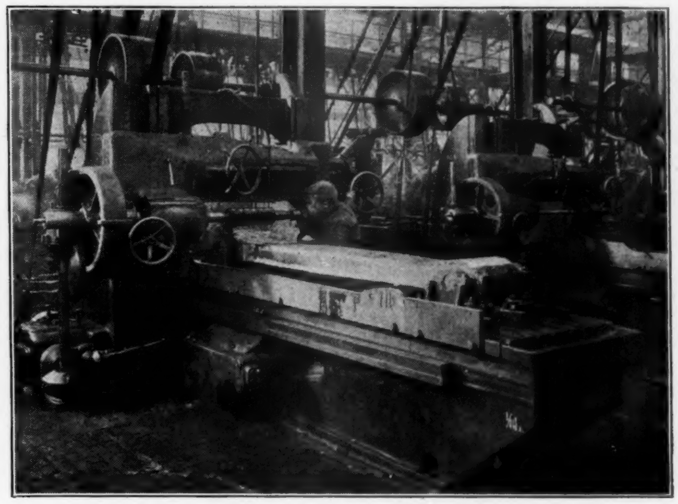
Wheel Foundry at Krupps

greatest of these concerns is Krupps at Essen, and among other things, this company is planning to go into the construction of railway materials on a large scale. Whereas before the war 50 per cent of its income was derived from war materials, at the present time the demand for them is practically eliminated and the only war material Krupps intends to make will be to meet the requirements of Ger-

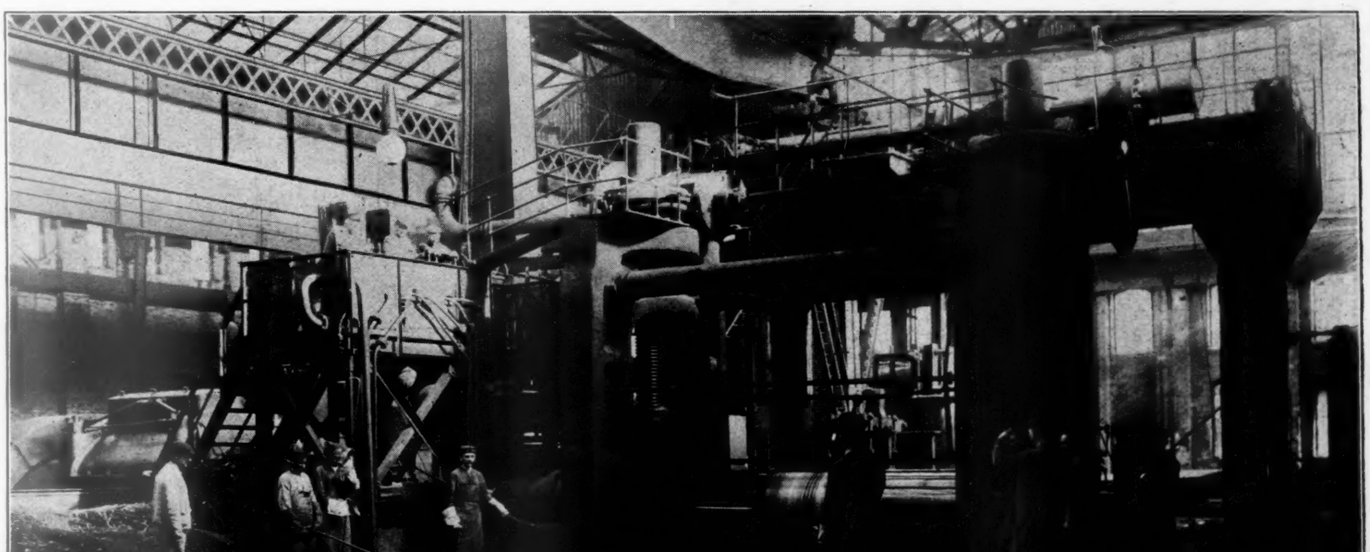
many's small army and navy. It is the intention of this company ultimately to be in a position to provide everything in the iron and steel line which goes to make up the construction of a railway. Before the war this company constructed a large amount of railway material, among which may be mentioned forged wheels and axles and springs of all types. During the war it increased its wheel and axle capacity by 100 per cent and at the present time it is building locomotives and cars at the rate of 300 and 2,000 per year, respectively, working two shifts a day. Plans have been made to increase this capacity to 900 locomotives and 20,000 cars as the occasion demands.



Milling Driving Boxes at Krupps



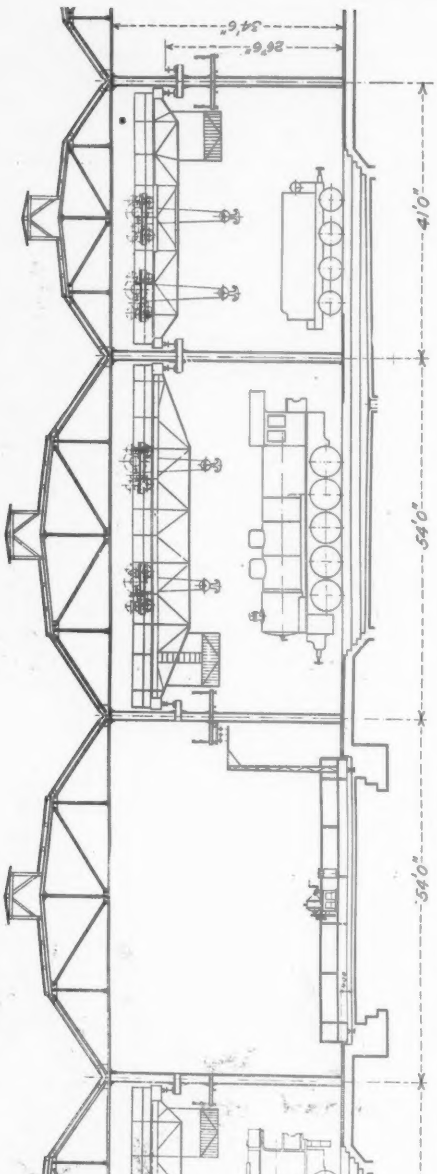
Milling Rod at Krupps New Locomotive Works



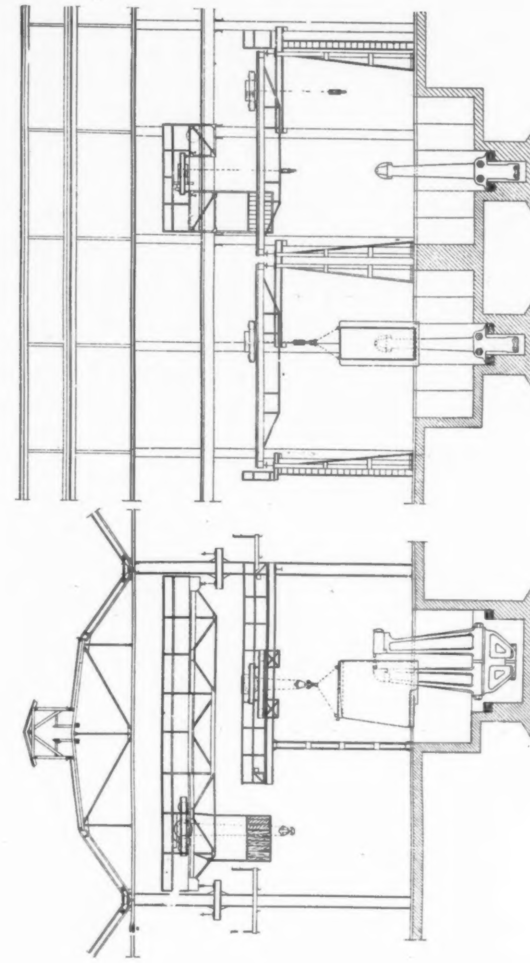
Armor Plate Mill for Rolling Plate and Locomotive Frames

The plant used for the manufacture of cars and locomotives is a new shop which was erected for the construction of guns and gun carriages and occupies a space of over 18 acres. These shops are particularly well located for the construction of railway equipment as they are adjacent to the main line of the railway through Essen, which has several sidings leading into the plant. The plant itself is well equipped with cranes and much of the machinery used for the munition work can be used to good advantage for the present work. The accompanying diagram shows an outline of the shop and the manner in which the material is routed through it. It contains 19 bays of medium size running parallel with one another, all being equipped with electric driven cranes. It has been possible thus to bring under one roof all the necessary operations in the construction of cars and locomotives with the exception of die making, forgings, castings, axles and wheels, which are made in other shops of Krupps plant.

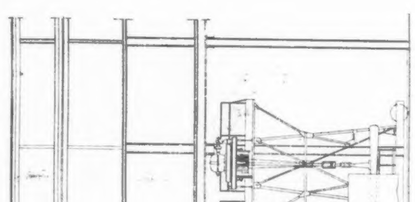
By referring to the diagram of the shop it will be seen that all materials for the construction of boilers, cranes and



Section Through the Five Bays in the Erecting Shop

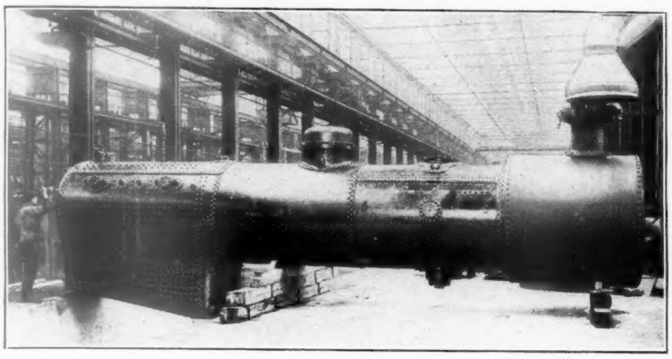


Section Through Boiler Shop Showing Hydraulic Riveters



Riveting the Boiler Barrel

tenders, with the exception of such parts as are made in the shop itself, enter the shop by a lead from the railway at the southern or right hand side of the building. After passing



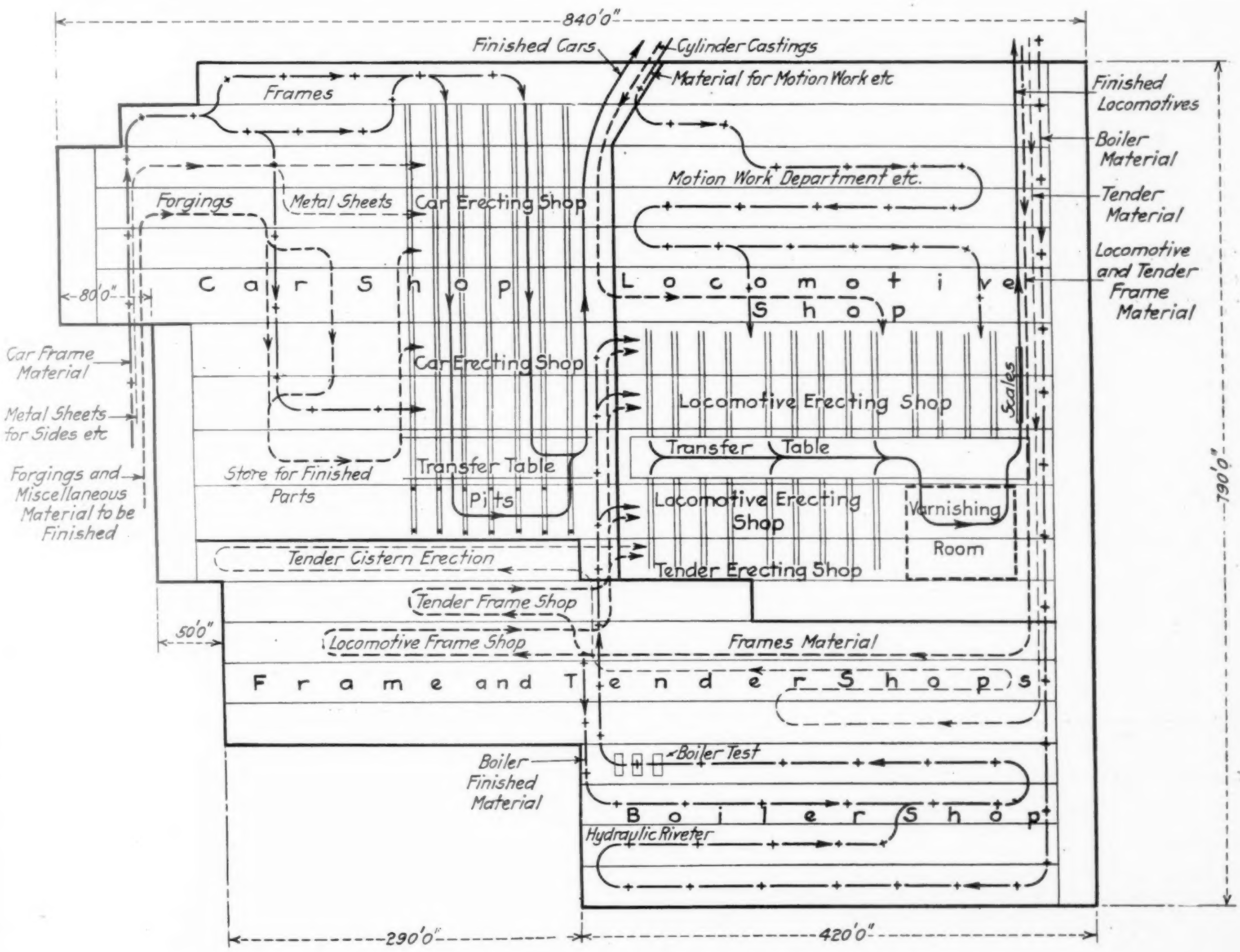
Testing Locomotive Boilers at Krupps

through the respective bays as indicated in the diagram, the boilers and frames are delivered to the erecting shop by way of a middle standard gage track which also communicates off the pits onto a transfer table and are delivered to the varnishing department where they are varnished and from there pass out over the locomotive scales to the railway by way of the southern railway siding.

The material for the car building section of the plant is delivered over the railway lead on the south or left hand side of the plant. The various finishing work is done in the bays indicated and follows on in a progressive direction to the longitudinal erecting shop and from there by means of another transfer table to the middle track and out of the shop onto the railway.

These shops are well equipped and have every convenience with the exception of a crane heavy enough to lift a finished locomotive and for this purpose electric jacks are used. The erecting pits are equipped with special gage plates not only for the standard gage but also for larger gages—for instance such as are used in Russia and Spain. Each of the manufacturing sections has its own tool department in order that the special tools required in the respective departments will be properly maintained.

Soon after the armistice the work of converting this plant was done and the work on the locomotives was started in



Plan of Krupps Locomotive and Car Shop and Routing of Work

with the main line railway. Likewise the routing of tender frames and cisterns can be followed.

The cylinders and material for the driving gear are delivered to the shops by the middle track and after passing through various departments for finishing are delivered directly to the erecting shop. The finished locomotives come March, 1919; the first locomotives and cars being turned out in December, 1919.

Export Situation in Germany

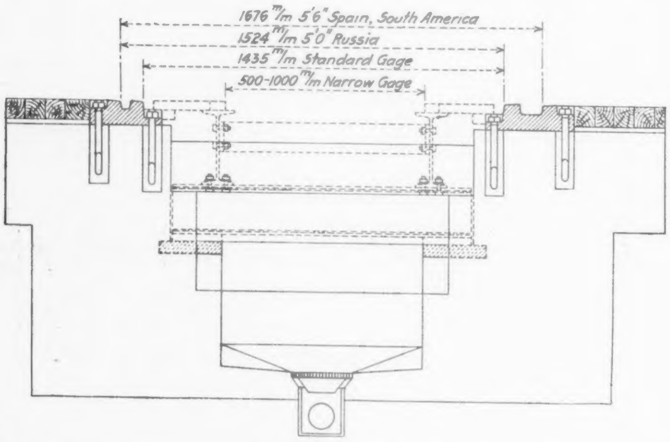
Shortly after the signing of the armistice great apprehensions were current lest Germany, in view of the low rate of

exchange which came into effect the early part of last year, should follow a policy of dumping its products on the foreign markets. To a certain extent this was done but it did not last for long on account of the lack of materials. There was a lack of sufficient labor and there was a demand for a certain amount of reconstruction within its own borders. There was a time, however, during last year when machine tools came into Holland so fast that they could not be handled. The situation grew so bad that it was not uncommon to have these exports lying in the open field uncovered and unprotected from the weather. They were sold on the ground for what they would bring.

What will be done in the future in the matter of exports depends upon the raw materials that can be obtained, and in this respect Germany is in a bad way. It suffers for the lack of coal; it must import most of its iron ore; its steel production has been greatly diminished and the labor situation has been most difficult. In addition to this the cost of labor and materials has, to the Germans, increased to an alarming extent.

In the year 1913, Germany produced about 175,000,000 tons of coal. Under the Peace Treaty it has lost about 35 per cent of its coal producing area and in addition it must deliver from 31,000,000 to 39,000,000 tons of coal to the Allies. The coal miners in Germany have the 7-hour day and the output per man has materially decreased and with it the quality of the coal.

Likewise Germany has lost 72 per cent of her ore fields and a large proportion of her pig iron and steel manufacturing facilities. The production of pig iron decreased from 19,309,000 metric tons in 1913 to 6,292,537 metric tons in 1919. Likewise the steel ingot production decreased in the ratio of 18,935,000 to 7,768,569. While the theoretical capacity of steel production under the present German boundaries is from 12,000,000 to 14,000,000 tons per year, Germany has only been obtaining a production of from 7,000,000 to 8,000,000 tons on account of the shortage of coal, iron ore



Cross Section of Erecting Pit in Krupps Shop Showing Arrangement for Varying Track Gauge

and the general labor conditions. As a general rule it may be stated that the cost of labor in Germany has increased from 500 to 700 per cent.

The cost of materials has risen very greatly. Basic pig iron prices have increased from about 60 marks per ton at the beginning of 1914, to 2,227 marks on March 1, 1920. Billets have increased from 100 marks to 2,290 marks. Plates have increased from 103 marks in January 1914, to 3,435 marks at the present time. Prices of ordinary steel has increased in like proportions.

These figures and the general condition of Germany today do not indicate that she will be in a position to do any very heavy export business but it must be remembered that the facilities for doing a vast amount of work still remains in Germany and as conditions become settled there will be a great demand for the use of these facilities. Germany is looking particularly to the Russian market. It is well known that the condition of railway equipment there is very bad and when a dependable government has been formed in Russia there will be great opportunities for big business.

It has been the policy of German industries in foreign trade to consolidate and there is at the present time an association known as the Verband Deutscher Wagonfabriken which is similar to the Railway Car Manufacturers Association in the United States, but with far greater powers

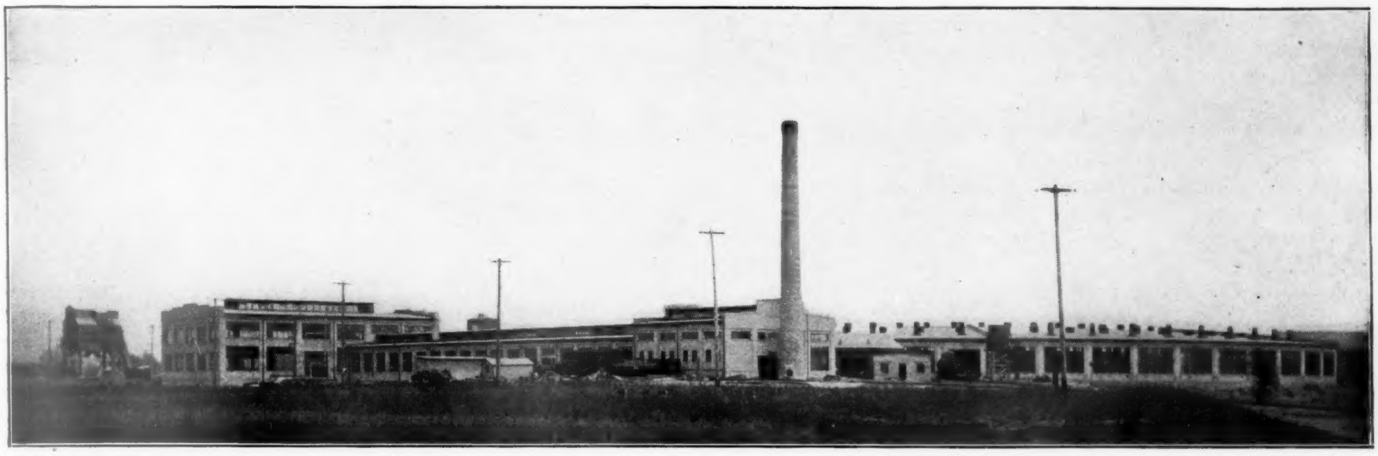
Typical Box Cars for German Railways

and more executive authority. This association has its head offices in Berlin and controls the prices of cars of all its members. Without doubt as Germany begins to find herself there will be more of these associations formed for the handling of export business.

A Hot Box.—In connection with recent earthquakes in Mexico a darky preacher down in Texas is said to have evolved a remarkable theory, which seems to fit in very well with certain existing circumstances. He promulgates his theory of the earthquakes as follows:

"We has received anudder warnin' not to go pesticatin' into de ways ob Providence. De earf, my breddren, revolutes on its axels, as we do now all know, and we all know dar mus' be sumefin to grease dem axels and it takes a right sma't ob grease to do it. So de good Lord done put de 'troleum inside de earf to keep de axels greased. Den byme bye 'long come all dese hyah oil companies, punchin' holes down into the bearin's and de oil all come squirten' out. Fust thing we know dar's a hot box, and de earf squeaks and jolts and rumbles and dat's de earfquake, and if dey don't quit pretty soon dere won't be no moah grease left and the earth will stick tight on its axels and won't go round no moah!"—*C. W. Savery Market Letter.*

Airplane Engines for Railway Locomotion.—A curious experiment has been tried in Germany to lessen somewhat the consumption of coal on the railroads by equipping a car especially built for experimental purposes with airplane engines and propellers, according to an article in the Scientific American. The car was built for standard gage track and was equipped with two standard airplane engines and propellers. The engines are of the six-cylinder type, and most likely of 275-hp. rating. One engine is mounted above the front platform on which are two barrels of fuel and apparently two automobile radiators which have been pressed into service, and the other engine and similar equipment is over the rear platform. No attempt has been made to streamline the car further than the cutting off of its forward corners so as to give an approximate wedge-shaped front end. It is stated that with 40 people aboard, this car attained a speed of 50 miles an hour.

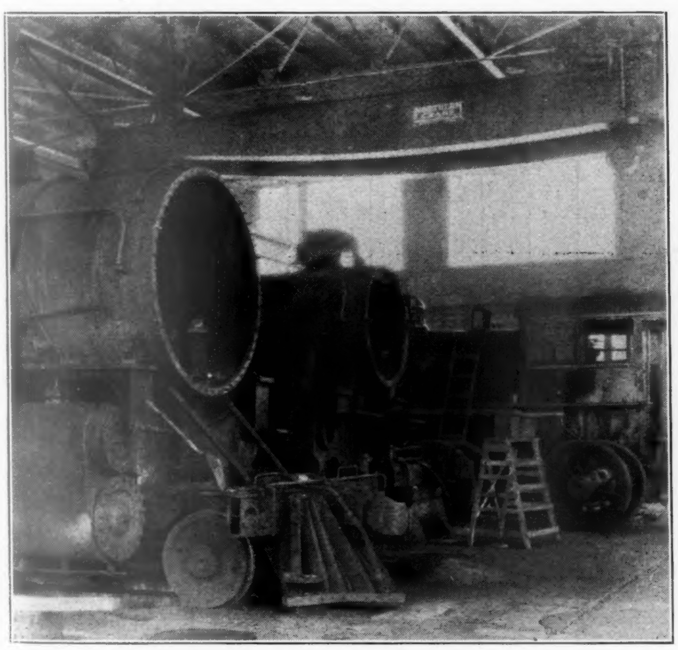


A Rear View of Terminal

M. C. Builds Engine Terminal at Niles, Mich.

New Division Point Established; Transfer made from Michigan City Without Serious Delay to Traffic

On December 9 and 10, 1919, the Michigan Central placed in operation a complete new freight engine terminal at Niles, Mich., and abandoned the operation of the Michigan City, Ind., terminal except for such locomotives as are required in local work. The new engine terminal is part of a project for the transfer of the freight terminals of the Middle and Western divisions from Michigan City to Niles in order to equalize the mileage and improve operating conditions. The Middle division formerly extended from Jackson, Mich., to Michigan City, Ind., a distance of 153 miles by the main line and 141 miles by the air line, which leaves the main line at Jackson and connects with it at Niles. The Western division, from Michigan City to Chicago, was 57 miles long. With the establishment of the new freight division point at Niles, the Middle division is reduced to a length of 116 miles by the main line and 104 miles by the air line, while the Western division is increased to a length of 92 miles.



Interior of the Erecting Shop

The terminal includes a modern 30-stall engine house of the shed-roof type, supported by four concrete posts between each pair of stalls, a 600-ton Link Belt coaling station, two cinder pit tracks over a 125-ft. concrete pit, and a six-pit locomotive repair shop. On the side of the roundhouse nearest the cinder pit, separate buildings have been erected, one to serve as an oil house and the other to house the offices of the engine despatcher and general foreman and to provide locker room and lavatories for the engine crews. The hot water washout and filling equipment and fuel oil storage for shop use are housed in separate structures adjoining the roundhouse and the powerhouse end of the repair shop building. The master mechanic's offices occupy a remodeled farmhouse fronting on what eventually will be made the main road between the division terminal and the city of Niles. Adjoining this building and also fronting on the road has been erected a two-story $50,000 hotel, operated by the railroad company for the benefit of the engine crews.

Relation of the Drop Pit Extension of the Roundhouse to the Back Shop

In addition to taking care of running repair work in the roundhouse, the shops are designed to handle the classified repairs to the locomotives assigned to the Western division, thus relieving the main shop at Jackson, Mich. The entire

plant, including the terminal and shop, employs about 350 men, those in the terminal working in three shifts and those in the back shop in one shift of eight hours each. The terminal turns about 70 to 80 engines a day and keeps 8 to 12 yard engines in service, the number varying with the different shifts.

The shop output is expected to range, and has been running, from four to six heavy repairs and two light repairs per month. At the outset the shop was handicapped by a lack of its full quota of machine tools. As the new tools have been received and placed in operation, the output has improved.

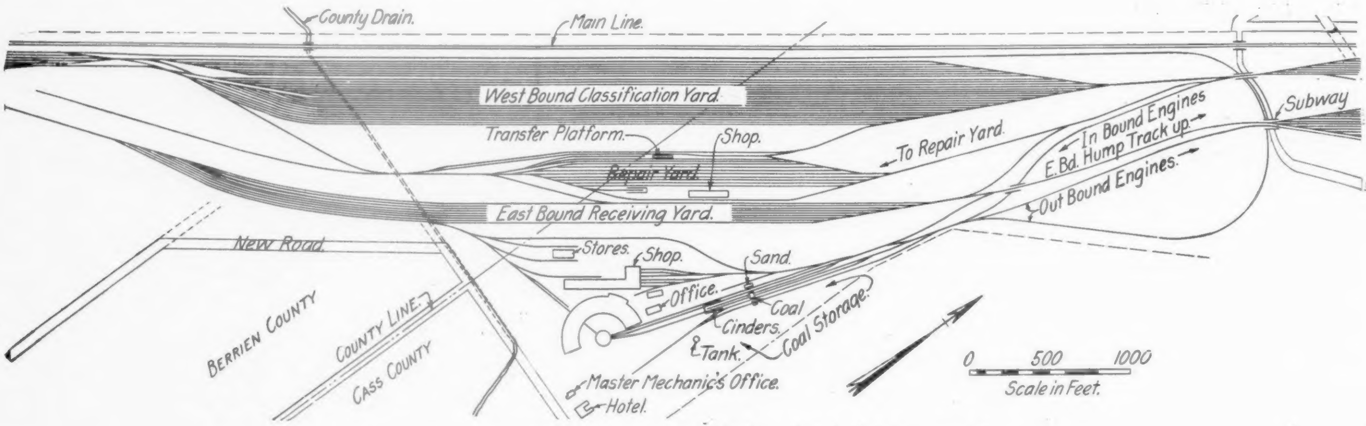
The Terminal Layout

At present only the westbound receiving and classification yards have been completed, with modifications necessary for handling both east and westbound traffic. Eventually, however, the complete project will include both east and westbound receiving and classification yards, which will modify the movement of engines through the terminal somewhat from the method now employed. The engine terminal layout consists of six tracks, two inbound, one outbound, one depressed cinder pit track, a coal-receiving track and an unloading track which passes over the receiving hopper of the coaling station. The two inbound tracks and the cinder pit track pass under the coaling station, the inbound tracks passing over the cinder pit, where cinders are dumped, wet down and shoveled by hand into cars standing on the depressed cinder track. When completed, the movement of engines in and out of the yard and through the terminal will follow the one-way plan. For outbound Western division engines this involves the use of a loop track which passes under the east and westbound humps through subways and extends alongside the entire length of the westbound classification yard to the westbound departure yard.

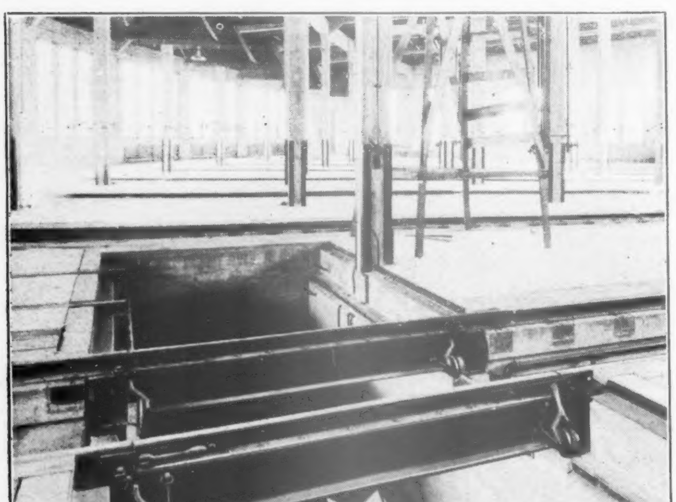
The Roundhouse

The 30-stall roundhouse is served by a 100-ft. turntable driven by a 22-hp. heavy-duty electric tractor. It has a depth of 109 ft. 9 in., with the inside circle 95 ft. in the clear from the edge of the turntable pit. The stalls are 15 ft. wide at the doors and 25 ft. 7 in. wide at the outside wall. The engine pits are 94 ft. long by 3 ft. 8 in. wide, with the sides recessed for the protection of the roundhouse heating system, which consists of four two-inch steam pipes fastened by brackets to the walls on each side of the pits. The pits have a depth of 3 ft. 6 in. at the rear ends and drain on a fall of one inch in ten feet toward a tunnel extending completely around the circle of the house at their door ends. The pit walls are of heavy, reinforced concrete 2 ft. 6 in. thick and are covered by planking, thus providing ample foundation for heavy jacking. The remainder of the enginehouse floor is covered with five inches of concrete.

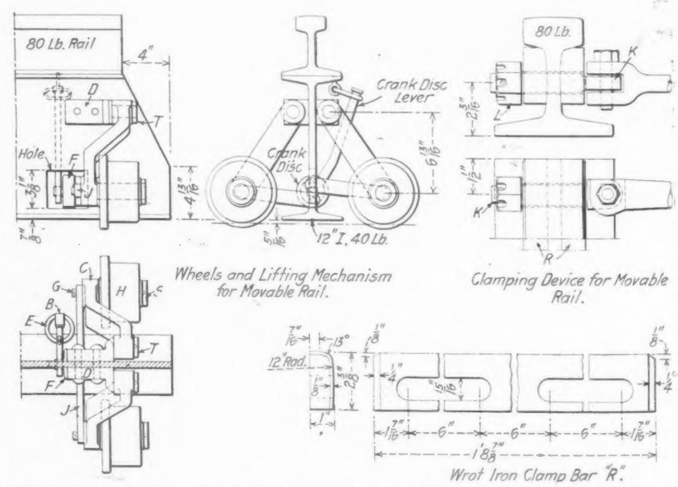
Back of the seventh to the eleventh stalls, inclusive, counting from the end of the house nearest the back shop, the rear wall is offset 12 ft. 3 in. Three of the five stalls in the extension are served by drop pits. The pit for drivers is



Layout Showing the Arrangement of In and Outbound Tracks



Arrangement of Movable Rails Over the Drop Pit



Details of Drop Pit Movable Rail Lifting and Clamping Device

located in the eighth stall at a distance of 70 ft. 10 in. from the inside wall of the house. This pit extends towards the seventh stall far enough to permit the location of the wheel track between the two stalls. The truck drop pit is located in stalls nine and ten, with the wheel track between them, at a distance of 79 ft. from the inside wall of the house.

The track arrangement at the drop pit section of the house is shown in one of the photographs. In the offset extension is placed a transverse track connected by two air-hoist operated turntables, with the wheel tracks from the drop pits. This track passes outside the roundhouse, through doors in the end of the offset extension, to another turntable and a track leading directly into the repair shop near the wheel lathe.

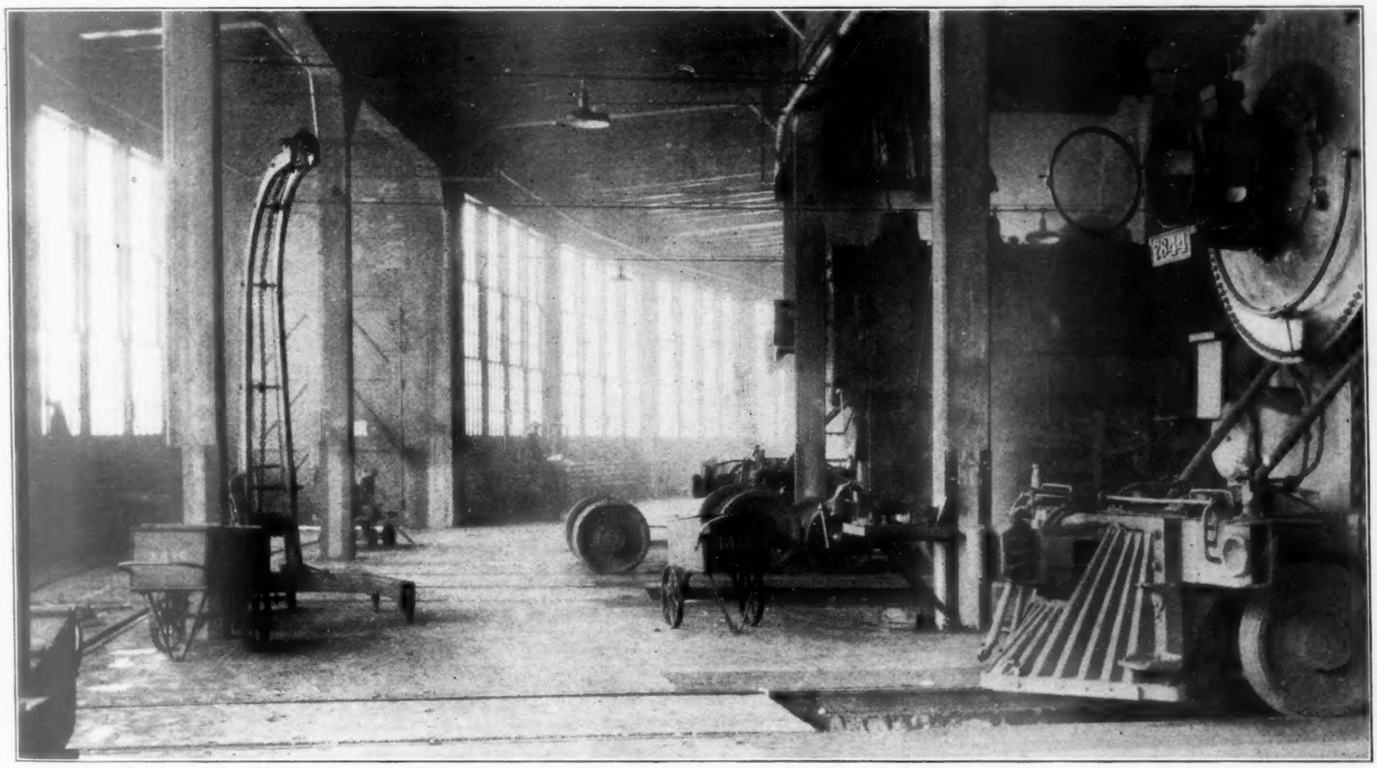
The roundhouse is provided with steam, compressed air, and cold water lines, the hot water washout and filling system lines and a fuel oil line for use in firing up. The steam blower line is carried around the house at the outside post circle with flexible pipe service connections carried down at each post. All other pipe lines are placed at the second post circle from the inside wall, the service connections being carried down at alternate posts, each set thus serving two stalls. The hot water, filling, washout and blowoff lines are carried outside or back of the posts, with the cold water, compressed air and fuel oil lines opposite. Each service outlet on the fuel oil line is fitted with a permanent hose and burner connection.

Erecting and Machine Shops

The repair shops, storehouse and power plant are housed in a single structure. This building is L-shaped, 486 ft. long and 60 ft. wide, with a 140-ft. wing, 102 ft. deep at one end. The erecting shop, which occupies the wing, is divided into two longitudinal bays 46 ft. and 53 ft. wide, with the wider bay adjoining the machine shop. A 30-ton Northern crane, with a 10-ton auxiliary hoist, travels throughout the length of this bay. There are six transverse pits in the erecting shop, spaced 22 ft. between centers. The four middle working pits are served by a continuous drop pit, the center of which is 46 ft. from the inside wall of the building and under the crane. These four pits are used for locomotive repairs, the wheeling and unwheeling being down on the drop pit. The outside working pit at the end of the wing is used for light and emergency repairs to locomotives when it is not necessary to drop any wheels. Owing to the location of the driving wheel lathe in the erecting shop, where crane service is available, the first pit does not extend the full width of the shop. At present the floor space occupied by this pit is used for carpenter shop and tank work.

Space is available for a future extension of the erecting shop at the end of the wing, as well as for the installation of a screwjack locomotive hoist.

The drop pits, both in the erecting shop and roundhouse, are designed for operation without the necessity of men entering the pits either for jacking, traversing or removing the rails. The jack is traversed along the pit by means of an air cylinder located alongside the jack track. The removable rail sections in the engine pit tracks are carried on simple elevating trucks, on which they are readily moved along the drop pit.

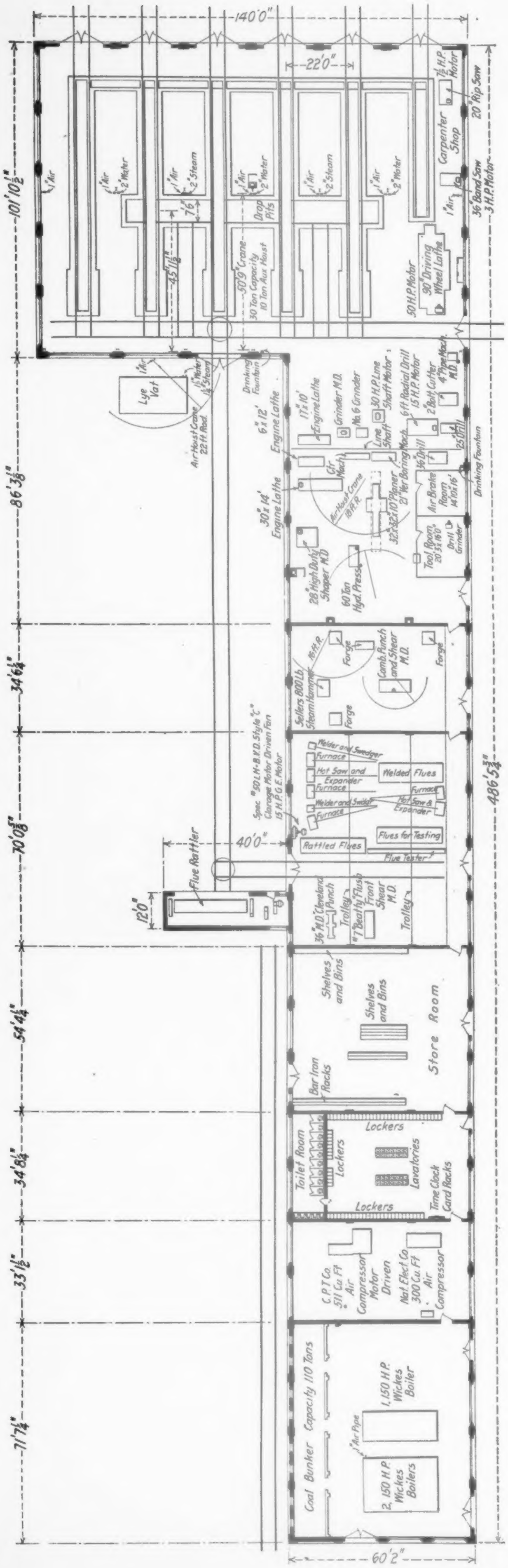


Interior of the Roundhouse, Showing the Extension at Drop Pits and the Wheel Track Arrangement

The movable rails are of 80-lb. section and are mounted on 12-in. 40-lb. I-beams. At each end two five-inch flanged wheels are attached to opposite sides of the I-beams, with swinging arms and a toggle link mechanism which permits the wheels to be lowered sufficiently to raise the I-beam free from its supports. The wheels rest on rails laid along the sides of the jack pit.

In dropping a pair of wheels, after they have been raised clear of the movable rails, the five-inch wheels are lowered by means of a lever which may be reached without entering the pit and the rail is rolled ahead of the jack to be placed in line with the wheel track after the wheels have been raised. Similarly, the other movable rail is moved up behind the jack, lowered in place, the wheels dropped on the rails and rolled off the pit. The operation of the jack and the jack traversing cylinder are controlled by valves located at the columns between the engine pits.

The machine shop occupies 86 ft. of the longitudinal por-



Plan of the Main Shop Building Including the Store and Power Plant

tion of the building adjoining the erecting shop. In addition to the old machine tools transferred from Michigan City, a number of new machines are being installed as fast as deliveries can be secured. These include a 90-in. wheel lathe, a vertical turret lathe, a 28-in. high-duty shaper and an 18-in. engine lathe. The majority of the older machines are group driven from a line shaft by a 30-hp. motor. The arrangement of the machine tools, which have already been placed in operation, is shown in the plan drawing of the shop.

Smith and Flue Shops

Adjoining the machine shop is the blacksmith shop, the two being separated by an 8-in. brick wall. The blacksmith shop occupies 34 ft. 6 in. of the building for its full width. It contains three hand forges, an open fire for large bar stock or other similar material, one 800-lb. steam hammer and a motor-driven combination punch and shear. The hammer, one of the hand forges and the open fire are under the swing of a 16-ft. jib crane and a smaller jib crane swings over the punch and shear.

The flue shop, which adjoins the blacksmith shop, is 70 ft. long and is closed at either end by 8-in. brick walls. Near the farther end of this shop a dry flue rattler is housed in a small structure built out from the side of the building adjoining the erecting shop wing. Counting from the machine shop end, the track over the third working pit in the erecting shop passes through the wing and is continued to the flue rattler. Provision is thus made for the movement of tubes from the erecting shop to the rattler, and thence they are moved directly into the flue shop on a transverse track connected with the longitudinal track by a turntable.

From the floor plan it will be seen that the path of the tubes through the shop is in the form of a loop starting from and ending at the transverse track, where the tubes are loaded on trucks for the return movement to the erecting shop.

The equipment of this shop consists of a welder and swager for superheater flues, a Ryerson combined hot saw and air-operated swaging and safe-ending machine for 2-in. tubes, a hot saw and expander for the front tube sheet ends of 2-in. tubes and a hydraulic tester. The swaging and welding machines are served by Economy combustion chamber furnaces burning fuel oil.

The Power Plant

The remainder of the building is occupied respectively by a 54-ft. store room, lavatory, locker and toilet rooms 35 ft. long, and the power plant. The latter is divided into two sections, the first of which occupies 33 ft. of the building and contains two air-compressors, one a new belt-connected, motor-driven compressor furnished by the Chicago Pneumatic Tool Company, of 511 cu. ft. capacity, the other a direct-connected, motor-driven compressor of 300 cu. ft. capacity, which was moved from the Michigan City shop.

The boiler room is 71 ft. 7 in. long, and at the present time contains three 150-hp. Wickes boilers, with room for the addition of two more units of the same size. An enclosed coal bunker of 110 tons' capacity is built in along one side of the boiler room. Along this side of the building is located a track which serves both the store room and the coal bunker.

All power for machine-tool drives, welding and lighting is three-phase, alternating current, furnished by the Indiana-Michigan Power Company of South Bend, Ind., at 4,000 volts, with transformers installed at the shops. The power and welding circuits are stepped down to 440 volts, while the lighting circuits are taken from a three-wire, 220-volt transformer, with the circuits arranged for 110-volt lamps.

Lighting

Both the shops and the roundhouse are lighted by 200-watt lamps in Maxilight reflectors. In the shops the lamps are suspended from the under side of the roof trusses. In the

roundhouse the wiring conduits and fixtures are carried on messenger cables suspended along each radial row of posts about 14 ft. above the floor. Each row carries two lights, alternating respectively between the middle of the first and third bays and the middle of the second and fourth bays. Drop cords for use with extension cord lamps are located near the second and third posts in each row.

The roundhouse eventually will be wired with a 440-volt circuit to permit the use of electric welding apparatus.

The Transfer from Michigan City

The placing in operation of the new terminal involved problems not usually encountered when moving into new shops. Practically a complete transfer of shop tools and equipment, material and working forces from Michigan City to Niles, a distance of 37 miles, was required. The distance made it necessary to arrange the transfer so that practically full running repair work could be continued at Michigan City to within a few hours of the time that all work was to be handled at Niles.

About a week before the proposed change all of the heavy machine tools, including the old wheel lathe, were moved to Niles, leaving only such of the smaller tools as were absolutely essential to maintaining running repairs at Michigan City. On December 8 and 9 a gang of machinists was sent to Niles to connect up and place the tools in operation.

From noon of December 9 all westbound Middle division trains were stopped at Niles and eastbound Western division trains were run through Michigan City to Niles. Enough mechanics were sent to Niles on the morning of the ninth to take care of the gradually increasing business from noon of December 9 to the morning of December 10.

On the evening of December 9 six cars of supplies and one car fitted up as a temporary tool room were despatched from Michigan City, arriving at Niles in time for the 6 o'clock morning business. By December 11 the new terminal was practically in full operation and only such power remained at Michigan City as had not yet been despatched following its arrival prior to noon of December 9. As rapidly as possible the supplies and tools were removed from the cars to their permanent quarters in the shop building. Most of the men still reside at Michigan City, and special shop trains are operated between Niles and Michigan City for their benefit.

The change was made with a minimum of light-engine mileage and no serious delays to traffic resulted, although some time was required to get the terminal as a whole to working smoothly. As has been stated, only the westbound receiving and classification yards have at present been completed with modifications necessary for handling both east and westbound traffic. The principal handicap in this respect was the fact that the eastbound yards were required to handle both east and westbound traffic, rather than any condition in the engine terminal itself.

FREDERICK J. HARRISON

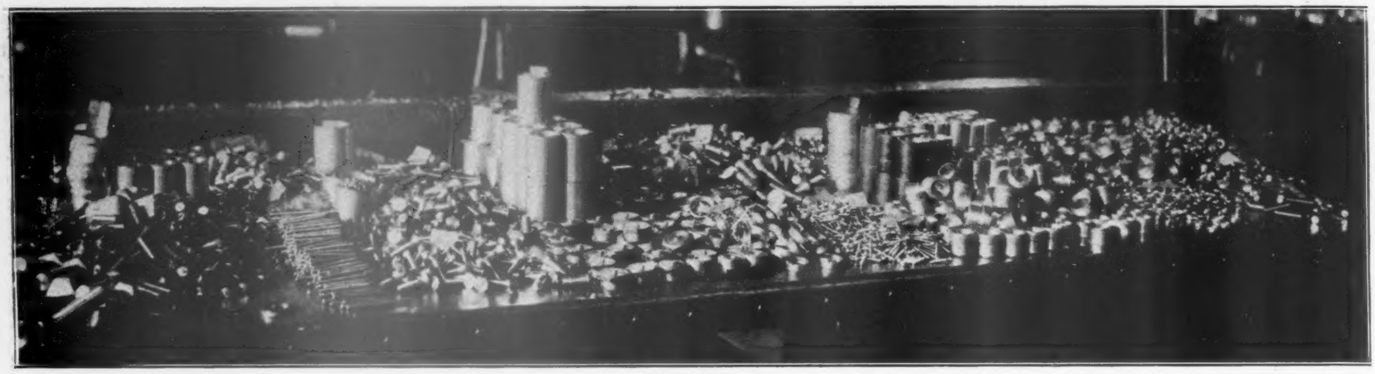
Frederick J. Harrison, superintendent of motive power of the Buffalo, Rochester & Pittsburgh since 1910, died at Du Bois, Pa., on April 16, following an illness of several months resulting from pneumonia. As superintendent of motive power of the Buffalo, Rochester & Pittsburgh, Mr. Harrison had full supervision over the executive and technical duties of the motive power department, which although not as large as that on many railroads was generally regarded as a model with respect to management and perfection of mechanical detail.

Mr. Harrison was born in Rochester, N. Y., on February 22, 1864, the son of Joseph Harrison, who was one of the old engineers on the New York Central. He attended school until he was 14 years of age and then started to learn the machinist trade, which vocation he followed for 11 years, being connected during this time with the Gleason Machine Works and the Graves Elevator Works. He then became a fireman on the New York Central, remaining in that service for about three years, sending in his resignation just one day before he was to be promoted to engineer. He resumed work as a machinist in October, 1888, in the shops of the Buffalo, Rochester & Pittsburgh at Rochester. In 1890 he was placed in charge of the shops as machine foreman and in 1894 was made general foreman in charge of the locomotive and car works at that point, which position he held for six years.

F. J. Harrison

In 1901 Mr. Harrison accepted a position as general foreman at the Du Bois Iron Works, but shortly after moving to Du Bois he re-entered the service of the B. R. & P. as general foreman of the shops then in course of construction at Du Bois. He supervised the installation of machinery, thus starting the new work at this point. Mr. Harrison was promoted to the position of master mechanic in 1904, having charge of the locomotive and car works not alone at Du Bois, but all points between East Salamanca and Pittsburgh. In 1910 he became superintendent of motive power.

Mr. Harrison was practically and thoroughly educated in his line of work. His judgment was held in high esteem by officials of the railroad with which he was connected, and his opinion and advice were sought at all times. Mr. Harrison had the opportunity to become more prominently identified with the activities of the community in which he was located than many railroad officials who are situated in larger centers, and it may be said that he contributed much toward establishing a friendly understanding between the public and the railroad that he represented. He was a prominent Rotarian and was affiliated with other local and Masonic organizations. Although Mr. Harrison held a position that frequently brought him in opposition to employees of the railroad, he always retained their confidence and a reputation for fair and square dealing that is recognized today as so important a factor on all railroads.



Output of Automatic Machines on the Inspection Bench

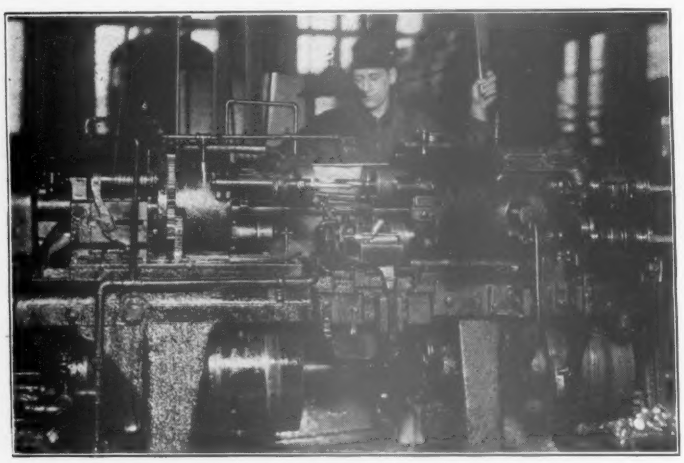
AUTOMATIC MACHINES AN AID TO ECONOMY

Work for Which Various Types Are Adapted; Minimum Quantity Economically Produced on Automatics

BY GEORGE W. ARMSTRONG

AUTOMATIC machine tool installations offer a possibility for reducing maintenance of equipment expense which has been largely overlooked. The urge has not been as imperative in the past as at present; due to the higher labor rates and individual decreased productive efficiency. Human nature is so constituted that it normally follows the line of least resistance. This results often in a tendency to stick to the old way, the means that are familiar, rather than to investigate and develop the latent possibilities of the unknown and untried. This may account in part at least for the meagre adaptation of automatic machine tools.

Lack of initiative should not become an insurmountable barrier to the realization of the sure economies, which can be effected through the acquisition of such valuable shop adjuncts. Their possibilities are not untried and unknown. Automatic screw machines have been in successful operation in railroad shops since 1900 and automatic chucking and turning lathes since 1905. Automatic screw machines are now being operated on eight or ten roads with profit, while automatic chucking and turning lathes are similarly successfully operated on three roads.



A Multiple Spindle Automatic

The degree of usefulness of automatics is further well illustrated by the scope of two large railroad installations. One road has 12 single spindle automatic screw machines, 4 multiple spindle screw machines, 16 automatic chucking and turning lathes and 3 automatic chucking lathes. The other has 34 single spindle automatic screw machines, 14 multiple spindle screw machines, 15 automatic chucking and turning lathes and 4 automatic chucking lathes. And this latter road is figuring on additional machines.

The Field for Automatics

Automatic machines are desirable in that more than one machine can be cared for by one operator because of the automatically controlled tool movements, spindle speed and feed changes. They are further, especially advantageous, due to the feature of mechanical output pacing. Manual labor in machine tool operation is largely transferred by automatic machines from the man to the machine. Productive capacity is controlled by fixed work cycles and the output expected is therefore definitely fixed, except for the contingencies of tool grinding, resetting tools and minor delays. This desired output is being used by at least two roads as a mark to shoot at, and the best of co-operation secured in realizing and often bettering this mark. Mechanical control of production as given by automatic machine operation has been a satisfactory means of securing uniform output and leveling the peak.

Automatic machine tool operation does not lend itself to promiscuous shop installation; to secure full benefits centralized installations should be made. Attaining full productive capacity requires that they be grouped at one point, where tooling equipment can be made and maintained, and where an organization can be built up to care for them. The automatic machine as now developed with standard tooling equipments is not a difficult machine to operate; standard cams have been developed too, which will take care of all usual ranges of work and these are very easily removed and reapplied.* Grouping of machines at one point, results in reduction of the idle investment in these auxiliary parts, as well as securing an experienced trained force to successfully devise the best uses of standard tools, and develop any special tools which may at times be required.

The natural result of centralized installation of automatic machines is the centralized production of parts and standardization as far as possible of suitable parts for such production. This, however, should not be a deterrent but a decidedly beneficial by-product. Centralized production of

*For a discussion of the operation of automatic machines, see article "Automatics in Railroad Shops," published in the *Railway Mechanical Engineer* issue for June, 1919, page 303.

largely used repair parts exerts a greater improvement in roundhouse maintenance than in shop operation and individual part cost economy. The effect in roundhouse operation is largely an intangible one from a dollars and cents standpoint, but an important one. Having in stock a finished or semi-finished part may often mean the difference of hours in returning an engine to service, and may in many instances prevent the loss of an engine on its regular run.

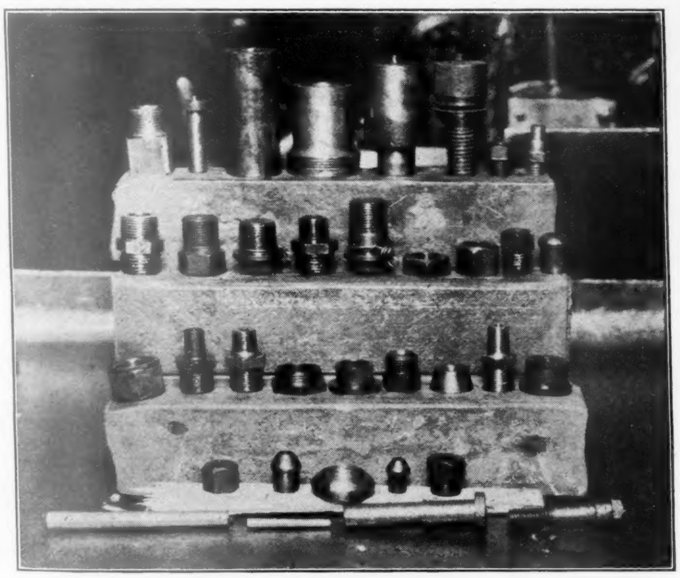
Types of Automatic Machines

Many types of automatic machines are available, but the particular type best suited depends upon the nature of the work. The following is a list of representative automatic machines of the more common types.

Automatic Lathes	Fay automatic. Reed-Prentice automatic. Le-Blond Multi-cut.
Automatic Chucking and Turning Lathes	Potter & Johnston. Guisholt.
Automatic Chucking Machines	New Britain. Bullard Mult-av-matics.
Automatic Screw Machines, Single Spindle	Gridley. Brown & Sharpe. Hartford. Cleveland.
Automatic Screw Machines Multiple Spindle	Gridley. National Acme. Radical. New Britain. Cincinnati. Cone.
Automatic Milling Machines	Cincinnati. Potter & Johnston. Pratt & Whitney.

Best Types for Handling Various Kinds of Work

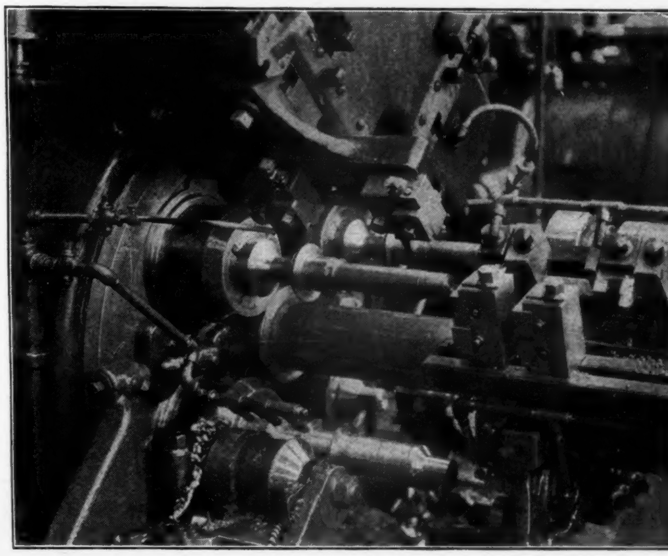
Automatic Lathes.—The automatic lathe is adapted for straight multi-diametered work with limited facing requirements. Front, back and intermediate crank pins are within its scope, but require the use of an auxiliary machine for threading, preferably a thread milling machine. Crosshead and knuckle pins could be similarly finished, and also motion work pins where the quantities required are too small to justify the use of automatic screw machines, or where a large head makes turning from a forging more economical than from bar stock. Flanges, crank pin collars, and similar work requiring only turning and facing can be admirably handled on this type of machine by using mandrels.



Locomotive Parts Produced on Automatic Screw Machines

Automatic Chucking Machine.—The automatic chucking machine is best adapted to boring, reaming and facing operations on small castings or forgings which can readily be held in chuck jaws. Its high productive capacity makes it suitable only for large quantity runs. This type of machine has five or more chucks with four or more tool working stations. The chucks are indexed so as to present the work to the respective tool stations in sequence. Work is therefore finished in the time required to perform the longest single operation, plus the time required to index the head. Removing and chucking pieces is done at the same time that machining is being done.

Multiple Spindle Screw Machine.—The multiple spindle automatic screw machine should be used where large production runs are available as staybolt sleeves, link bushings, set screws, etc. The use of the multiple spindle machine, however, is not advisable for initial installations, general use and large diametral capacity, for which purposes the single spindle automatic screw machine is better suited. Where the quantities required are large the multiple spindle machine is desirable as it combines four or more machines in one, and the work is produced in the time of the longest single operation plus the time to index the spindle head. Tools are operated on each bar in succession, cutting off the finished piece in the fourth position, ready to feed the bar forward as the head indexes. Production time can be reduced by dividing the longest operation between two spindles wherever possible, for example, a long turning or drilling operation. Threading can be done on an automatic screw machine, but it will usually be found that greater production, due to higher cutting speed and feed, can be secured if threading is done independently, preferably on a bolt threading machine. Where a set-up man is employed, a substantial reduction can be effected by using a machinist helper to thread parts and the set-up man to adjust the dies.



A Typical Tool Set Upon a Multiple Spindle Screw Machine

Automatic Milling Machine.—The automatic milling machine has been very little utilized in railroad shops except for milling square and hexagon bosses on caps and similar pieces. Aside from the Potter & Johnston machine, those available are rather restricted in scope which may partly account for this fact. Then, too, the latest type of plain, knee type milling machines are equipped with trip dogs for table movement which make them semi-automatic in operation. However, there is considerable milling work in large quantities as rod keys, piston keys, shoes, etc., which could be profitably handled on automatic milling machines and deserves consideration.

Automatic Chucking Machine.—The automatic chucking machine is well adapted to finishing castings and forgings.

Tool set-up is virtually that of good turret lathe practice, using multiple tooling set-ups, for simultaneous turning, boring, drilling or reaming with turret face and facing with the cross-slide. The turret travel and indexing, cross-slide movements, spindle speed and turret and cross-slide feeds, as well as the co-ordinated operation of turret and cross-slide are controlled by trip dogs and cams on the cam shaft in the base of the machine. The articles to be machined are usually held by means of a regular convertible two-jaw to three-jaw universal lathe chuck, fitted in most cases with false jaws. Wherever it is possible to true the false jaws in place, they are left soft and frequently trued up to maintain accuracy, especially where holding a turned surface for a second operation.

All operations of this type of machine are automatically performed after the piece is chucked and the starting lever thrown off. At the completion of the cycle, the machine is automatically tripped and stopped, thus preventing a repetition of the cycle and possible spoiling of work should the operator be occupied elsewhere. This feature can also be made use of in tapping or threading with a collapsing tool. To insure the operator's attention during this operation, the threading tool can be placed on the first face, so that the automatic trip feature stops the machine prior to this operation. It then requires the operator to start the machine for

A Battery of Automatic Chucking Machines

threading or tapping and to also stop it again to remove the piece and chuck a new one.

This type of machine is now being used for a wide range of parts, some of which are given below.

Bell ringer cylinders.	Injector flanges.
Bell ringer pistons.	Crank pin collars.
Air pump piston heads.	Knuckle pins.
Tank hose nuts.	Air valve cages.
Injector pipe nuts.	Eccentric rod bushings.
Crosshead pin nuts.	Piston valve bull rings.
Knuckle pin nuts.	Piston valve packing rings.
Air pump packing rings.	Boiler check bodies.
Oil cup covers.	Grease cup covers.
Packing sliding plate rings.	Knuckle pin bushings.

Single Spindle Screw Machines.—The single spindle automatic screw machine has perhaps the largest field in railroad shops. The set-up required is less complicated than that of the multiple spindle automatic screw machine, and the range in the diameter of bar greater. This greater simplicity in tooling and camming makes it possible to utilize it for much work in quantities too small for economical multiple spindle production and which would otherwise require the use of a turret lathe. Turret lathes have a very wide field of usefulness in railroad as well as industrial shops which has by no means been fully developed. However, the turret lathe requiring individual attention and operation should not be used, where runs of articles are required in quantities adapted to automatic machine production and consequent multiple machine operation.

Automatic screw machines, single and multiple spindle, are used in railroad shops for finishing the following parts:

Crosshead shoe bolts.	Spring rigging bushings.
Spring bolts.	Spring rigging pins.
Brake bolts.	Lift shaft bolts.
Reach rod bolts.	Rod dowels.
Trailer box bolts.	Eccentric set screws.
Patch bolts.	Brake rollers.
Eccentric rod pins.	Studs.
Valve rod pins.	Reversing valve plates.
Motion work bushings.	Oil cups.
Link pins	Main rod key washers.
Throttle lever bolts.	Nuts of various kinds.
Lubricator connections.	Packing glands.
Staybolt sleeves.	Valve stems.
Taper pins.	Set screws.
Cap screws.	

Operation of Automatics

Two to four automatic screw machines are being handled easily by one operator and generally two automatic chucking and turning machines. The automatic chucking lathe is a multiple chuck machine and requires one man per machine. Many industrial installations have been made where the operator takes care of an automatic chucking and turning machine and one or two single or multiple spindle automatic screw machines, which practice might be followed in initiating railroad installations.

Complete, detailed records should be kept of the camming and tool set-up for each job, so as to prevent the necessity of the operator remembering the set-up or as is more often the case, working it out again, which is necessarily a waste of time. This record will also serve to preserve the best set-up features and insure maximum production at all times. Record sheets are generally furnished by the machine manufacturer on request.

Maintenance of Automatics

The operating statistics of one large railroad installation may be of interest as showing what has been accomplished with automatic machines and also to show that they are not difficult machines to maintain in repair. With the exception of abnormal allowance for one group of two machines, the figures show very good performance, and demonstrate that automatic machines are consistent producers with little delay for repairs.

Operating Statistics, Automatic Machines

Year	No. machines in operation	Hours per machine: Man assigned to other duties	Man off	Making repairs	Actual time working and setting up
Potter & Johnston					
1917............	6	159.0	181.4	225.5	1,598.2
1918............	12	314.8	500.8	113.5	2,060.5
1919............	16	177.9	153.2	69.23	1,792.9
Average		222.86	280.9	112.5	1,823.6
Gridley 3¼ in. Single Spindle					
1915............	2	.....	1,120	536.0	2,941.0
1916............	2	.....	643.75	1,057.5	3,529.75
1917............	2	218.75	51.5	1,414.25	915.5
1918............	2	28.5	258.0	652.0	1,950.25
1919............	2	136.0	355.0	964.5	908.25
Average		76.65	485.7	924.9	2,046.95
Gridley 2¼ in. Multiple Spindle					
1918............	4	356.0	680.0	581.0	2,061.9
1919............	4	65.6	181.9	231.0	2,824.4
Average		77.34	175.4	418.6	2,442.1
Gridley 4¼ in. Single Spindle					
1918............	5	139.9	332.2	258.3	2,125.7
1919............	9	98.5	165.3	82.2	2,940.5
Average		132.2	224.9	145.1	2,649.3

Minimum Economical Run

The question often uppermost in the mind of the man considering automatic machine operation, or contemplating new work on his existing installations, is, "What is the minimum quantity I can afford to run?" An accurate answer must necessarily require accurate data which would not be available. However, an approximate solution which will fulfill the object desired can be secured from previous similar performances or conservative estimated time. The same method can also be employed to determine accurately the

quantity after actual operating figures have been developed.

The minimum economical production will necessarily be such a quantity that the automatic machine cost will be equal to the cost on the turret lathe. Material will not differ in either case, where good practice prevails, so that this item can properly be disregarded. This will be true except in the limited cases where forgings might be used in turret lathe practice, whereas the automatic screw machine would produce from bar stock. Forging cost will often serve as ample offset to the extra material cost, or else the use of the proper automatic machine will again duplicate turret lathe procedure in finishing the forgings. Direct labor cost and overhead expense are therefore the determining factors governing the minimum economical production.

Let s = set-up time in hours on the automatic
s_1 = set-up time in hours on the turret lathe
t = production time in hours per piece on the automatic
t_1 = production time in hours per piece on the turret lathe
n = number of pieces to be finished
q = number of automatic machines operated per operator
r = hourly rate of the automatic operator
r_1 = hourly rate of the turret lathe operator
R = hourly rate of the automatic set-up man
O = rate in per cent of automatic overhead expense
O_1 = rate in per cent of turret lathe overhead expense

The cost on the automatic machine will be

$$s(r+R)+\frac{ntr}{q}+\frac{O}{100}\left[s(r+R)+\frac{ntr}{q}\right]$$

The assumption has been made that while setting up a machine the other automatic machines in the individual battery will be idle. While not strictly true for automatic screw machines, until material being worked on is cut up, it will be realized that this assumption is an error on the side of safety, as the benefit is given for any production resulting during the time of setting up.

Also the cost on the turret lathe will be

$$s_1 r_1 + n t_1 r_1 + \frac{O_1}{100}\left[s_1 r_1 + n t_1 r_1\right]$$

Equating and solving we have

$$n=\frac{\left[\left(1+\frac{O}{100}\right)s(r+R)\right]-\left(1+\frac{O_1}{100}\right)s_1 r_1}{\left(1+\frac{O_1}{100}\right)t_1 r_1-\left(1+\frac{O}{100}\right)\frac{tr}{q}}$$

Solving this equation will give the minimum economical production run for any particular job to compete with turret lathe operation. Illustrative of its practical application we will assume a typical case, and solve for the economical quantity.

Let s = automatic set-up time be 4 hrs.
s_1 = turret lathe set-up time be .5 hrs.
t = automatic production time be .1 hr.
t_1 = turret lathe production time be .25 hr.
r = automatic operators rate .72 per hour
r_1 = turret lathe operators rate .76 per hour
R = Set-up man's rate .84 per hour
d = automatics per operator, 2
O = overhead on automatics 175 per cent
O_1 = overhead on turret lathe 60 per cent

Then

$$n=\frac{\left[\left(1+\frac{175}{100}\right)4\,(.75+.84)\right]-\left(1+\frac{60}{100}\right).5\times.76}{\left(1+\frac{60}{100}\right).25\times.76-\left(1+\frac{175}{100}\right)\frac{.1\times.72}{2}}$$

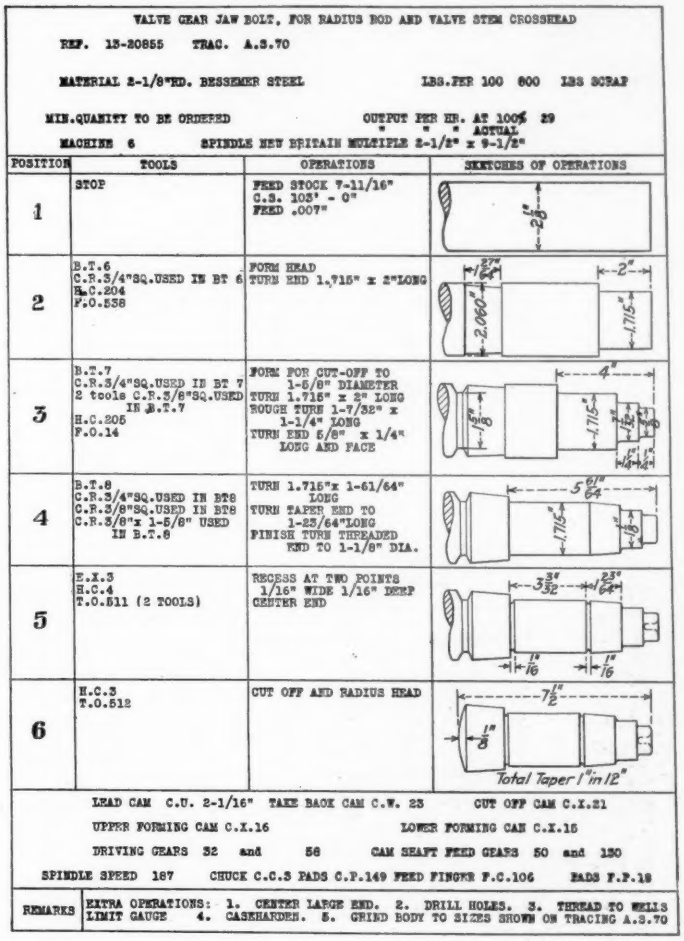
Solving

n or minimum production = 44.3 pieces.

Automatic machines have been a profitable investment for the railroads now using them. The statement was recently made that two months' production on one multiple spindle automatic screw machine saved enough to pay for the machine. This was an exceptional result, but the possibilities for economy are large.

Automatic machines will produce and they will produce uniformly. The care and attention required to effectively maintain an automatic machine is no more than that which should be accorded any other machine tool. The unfavorable contrast where it does exist is due to an inferior maintenance of general purpose machine tools, and that an engine lathe "shot to pieces" can be made to produce where an automatic machine will not effectively.

Labor rates are high and will continue high, individual productivity is low and may be improved in time; but automatic machine installations offer a certainty of consistent increased output and decreased expense.



VALVE GEAR JAW BOLT, FOR RADIUS ROD AND VALVE STEM CROSSHEAD

REF. 13-20855 TRAC. A.S.70

MATERIAL 2-1/8"RD. BESSEMER STEEL LBS.PER 100 800 LBS SCRAP

MIN.QUANITY TO BE ORDERED OUTPUT PER HR. AT 100% 29
" " " ACTUAL

MACHINE 6 SPINDLE NEW BRITAIN MULTIPLE 2-1/2" x 9-1/2"

POSITION	TOOLS	OPERATIONS	SKETCHES OF OPERATIONS
1	STOP	FEED STOCK 7-11/16" C.S. 103' - 0" FEED .007"	
2	B.T.6 C.R.3/4"SQ.USED IN BT 6 H.C.204 F.O.538	FORM HEAD TURN END 1.715" x 2"LONG	
3	B.T.7 C.R.3/4"SQ.USED IN BT 7 2 tools C.R.3/8"SQ.USED IN B.T.7 H.C.205 F.O.14	FORM FOR CUT-OFF TO 1-5/8" DIAMETER TURN 1.715" x 2" LONG ROUGH TURN 1-7/32" x 1-1/4" LONG TURN END 5/8" x 1/4" LONG AND FACE	
4	B.T.8 C.R.3/4"SQ.USED IN BT8 C.R.3/8"SQ.USED IN BT8 C.R.3/8"x 1-5/8" USED IN B.T.8	TURN 1.715"x 1-61/64" LONG TURN TAPER END TO 1-23/64"LONG FINISH TURN THREADED END TO 1-1/8" DIA.	
5	E.X.3 H.C.4 T.O.511 (2 TOOLS)	RECESS AT TWO POINTS 1/16" WIDE 1/16" DEEP CENTER END	
6	H.C.3 T.O.512	CUT OFF AND RADIUS HEAD	Total Taper 1" in 12"

LEAD CAM C.U. 2-1/16" TAKE BACK CAM C.W. 23 CUT OFF CAM C.X.21

UPPER FORMING CAM C.X.16 LOWER FORMING CAM C.X.15

DRIVING GEARS 32 and 56 CAM SHAFT FEED GEARS 50 and 130

SPINDLE SPEED 187 CHUCK C.C.3 PADS C.P.149 FEED FINGER F.C.106 PADS F.P.18

REMARKS: EXTRA OPERATIONS: 1. CENTER LARGE END. 2. DRILL HOLES. 3. THREAD TO WELLS LIMIT GAUGE 4. CASEHARDEN. 5. GRIND BODY TO SIZES SHOWN ON TRACING A.S.70

Form for Recording Setup of Multiple Spindle Automatic

RANGES IN STEAM CONSUMPTION BY PRIME MOVERS

Fuel consumption is the direct result of water evaporated and evaporation depends on the steam demands of the engine. The following table shows steam consumption under average plant conditions for different types of engines using saturated steam compared with those using superheated steam at 100 deg. and at 200 deg. superheat.

	Steam consumption, lb. per hp. hr.		
Type Engine	Saturated steam	100 Deg. superheat.	200 Deg. superheat.
Simple non-condensing	29-45	20-38	18-35
Simple non-condensing automatic	26-40	18-34	16-30
Simple non-condensing Corliss	26-35	18-30	.....
Compound non-condensing	19-28	15-25	13-22
Compound condensing	12-22	10-20	9-17
Simple duplex steam pumps	120-200	80-160	.....
Turbines non-condensing (kw. hr.)	28-60	24-54	21-48
Turbines condensing (kw. hr.)	12-42	10-38	9-34

Depending on the efficiency of the engine itself, it will be seen that superheating shows substantial economies in steam consumption. It should be noted, also, that the percentage of savings varies from 9 to 33 per cent for 100 deg. superheat to from 19 to 38 per cent for 200 deg. superheat.—*Power Plant Engineering.*

AIR BRAKE ASSOCIATION HOLDS LIVE CONVENTION

Important Problems Dealt with from Standpoint of Effect on Revenue and Operating Efficiency

SUBJECTS having an important bearing on railroad operating conditions were discussed at the twenty-seventh annual convention of the Air Brake Association, which opened on May 4, at the Hotel Sherman, Chicago.

Following the usual opening exercises, Frank McManamy, manager department of equipment, Division of Liquidation of Claims, United States Railroad Administration, delivered an informal address, which was followed by the address of T. F. Lyons, president of the association.

Mr. McManamy's Address

In his talk Mr. McManamy offered two suggestions for the consideration of the association. He first drew attention to the comparatively small number of men who are charged with the responsibility of supervising the maintenance and operation of air brake equipment. This was brought out forcibly by comparison with the equipment under the supervision of the road foreman of engines. Each road foreman supervises the operation of the locomotives on one division or less, these locomotives always remaining on the division and running into one or the other of the terminals at least once every 24 hours where they are available for necessary repairs. Usually one air brake supervisor, alone or with comparatively few assistants, must supervise the air brake equipment in operation on an entire system, much of which, in the case of freight cars he may never see but once during its life.

Mr. McManamy suggested that air brake departments need reorganization to provide more supervisors directly responsible for air brake conditions, to provide adequate equipment for making repairs, not at one terminal alone, but at every terminal on the road and he pointed out that to secure these things the support of the management must be secured. As one means of securing this needed support, he recommended that the Air Brake Association affiliate with the American Railroad Association, as such affiliation would bring the recommendations of the air brake men of the country in a position to receive the backing of an authoritative body.

In closing Mr. McManamy paid a high tribute to the support given the Railroad Administration during its period of control by the members of the association and other railroad men.

Address of the President

In his address, President Lyons dealt particularly with the advantages of attendance at the convention and the responsibility of the members to participate in the activities of the association. Foremost of these is the responsibility of taking such an interest in the discussion as will insure that each subject is thoroughly covered, the time and labor expended in the preparation of papers and committee reports for presentation meriting the most careful attention by the members. Among the benefits which the members receive from convention attendance, Mr. Lyons dwelt on the opportunity to talk shop with other air brake men outside the convention hall, from which talks are received many valuable suggestions directly applicable to the solution of his own problems by each member.

T. F. Lyons (N. Y. C.)
President

L. P. Streeter (Ill. Cent.)
First Vice-President

Mark Purcell (Nor. Pac.)
Second Vice-President

BETTER MAINTENANCE OF AIR COMPRESSORS*

By Mark Purcell
General Air Brake Inspector, Northern Pacific

When direct inquiry is made, the usual impression is that compressors are giving good service. At the same time service records may show a large amount of wheel sliding and breaking in two of trains that, at first, does not appear to have any relation to the manner in which the compressors are operating, for which the compressor is largely responsible.

If a compressor runs slow, or for any reason raises pressure slowly, there may not be enough accumulated after a brake application to make a proper release, with the result that a part of the brakes only are released and wheels are slid or drawbars pulled out. Still the compressor has not actually refused to work.

Most of the low efficiency and some of the failures are due to lack of repairs, or the quality of the repairs made being often only slightly below the standard required. In

*Submitted by the North-West Air Brake Club.

some cases it is an error in a single feature, but more often a combination, such as a number of leaks, any of which may be too slight to cause trouble, yet when combined are serious. The above applies more particularly to compressors having steam and air cylinders compounded, on account of the balancing effect that may be caused by leakage.

It is not uncommon to find a compound compressor that is chronically inefficient, and be advised that one part after another has been repaired or replaced, until all or nearly all of the working parts have been gone over, and yet the operation is not improved.

In one case an 8½ in. cross compound compressor developed pounding, would not supply sufficient air, and the engine had to be taken off an important train. Examination showed that the rings in both the high and low pressure air pistons were 3-16 in. to 5-16 in. open at the ends and lacked about .0012 in. of filling the ring grooves. New rings that would fit the cylinders, .0012 in. smaller than the grooves, were applied to both the air pistons, and the compressor gave good service for four months, and probably longer.

Another 8½ in. cross compound compressor pounded to some extent and ran so slow with 190 lb. steam pressure that it would not keep up 90 lb. standard brake pipe pressure on a regular passenger train of 10 cars, against normal leakage. Examination showed:

(a)—Main steam and air cylinders slightly worn.
(b)—Steam cylinder head parts in good condition.
(c)—Main steam and air pistons about 1-32 in. smaller in diameter than their cylinders.
(d)—Packing rings in steam and air cylinders came together at the ends in the smallest part of the cylinders and were a little less than 3-32 in. open in the largest parts of the cylinders.
(e)—Rings lacked .005 in. to .008 in. of filling the grooves in the high pressure steam cylinder.
(f)—Rings in the low pressure steam cylinder lacked .0012 in. to .0015 in. of filling the grooves.
(g)—Rings in the high pressure air cylinder lacked .0015 in. to .0018 in. of filling the grooves.
(h)—Rings in the low pressure air cylinder lacked .0012 in. to .0015 in. of filling the grooves.
(i)—The upper final discharge valve had 3-16 in. lift, one upper intermediate valve had 7-32 in. lift and the other air valves had only slightly more than standard lift.

New pistons that would fit the cylinders closely at the smallest part, and in which the rings fitted the grooves with just enough clearance to expand by their own tension when compressed into the grooves, were applied and no other repairs made. The compressor was given a severe running test in which its capacity and speed were fully up to the standard.

Recommended standards to cover repairing and adjustment of the different parts of compressors have been published extensively and discussed ever since the cross compound compressor came into use, but general observation would indicate that these appear seldom to be considered in connection with compressor maintenance. The general standard of service of these compressors is thus considerably below what may reasonably be obtained at slightly increased cost, by simply following standards such as those outlined in the recommended practice by the Air Brake Association.

The number of engine failures chargeable to the air compressor alone, indicates the need for improved compressor maintenance, and this is emphasized by the other troubles that can readily be traced directly to a lowered compressor efficiency.

Discussion

The paper drew out a lively discussion which, however, dealt more with the various causes of failure, particularly of the cross compound pump, than the details of maintenance. One of the most frequently mentioned causes of failure was improper lubrication, there being set forth a diversity of opinions and methods for oiling the air cylinders of the cross compound compressors, but a general agreement that a satisfactory system of lubricating these cylinders has yet to be developed. One of the measures to be taken to avoid air pump failures and excessive maintenance is to give close attention to brake pipe leakage and in doing this not to overlook the brake cylinder.

G. H. Wood (A., T. & S. F.)
Third Vice-President

F. M. Nellis (Westinghouse Air Brake Co.) Secretary

Otto Best (Nathan Mfg. Co.)
Treasurer

The suitability of the orifice condemning test as a means of determining whether a pump is in condition for every class of service was questioned by several members. and was the subject of considerable discussion. The point was made that a pump which may just pass the condemning test may not be suitable for service on long, heavy trains in heavy grade territory. It was brought out in the discussion that the Interstate Commerce Commission condemning tests allow only about 10 per cent depreciation below the rated capacity of cross compound pumps, while the percentage is higher for other types and it was suggested that the degree of efficiency essential in any particular class of service should first be established and the test for that class of service modified to maintain that efficiency.

The members quite generally agreed with the author of this paper as to the desirability of tightening up generally on air compressor maintenance, one of the reasons that was particularly stressed being the damage done in service by failure of the brakes properly to release in cycling, this being frequently caused by the inability of a poorly maintained pump to raise the main reservoir pressure within the time allowed by the cycle, even though it may pass the condemning test.

TERMINAL TESTS OF AIR BRAKES

By W. P. Borland
Chief Bureau of Safety, Interstate Commerce Commission

There is no disposition on the part of the Interstate Commerce Commission at the present time to take extreme measures in its administration of the power brake provisions of the safety appliance law; but the time has arrived when better observance of the requirements of law by those who are responsible for the condition of air brake equipment may well be insisted upon.

The percentage of non-air cars now in service is so small as to be negligible. In air brake tests of 1,196 trains departing from terminals last year, comprising a total of 41,846 cars, inspectors of the Bureau of Safety found but 6 non-air cars. There is no longer any lack of available equipment, and any failure to comply with the requirements of law must be ascribed to neglect of the condition of equipment.

In the terminal tests above referred to our inspectors found 330 cars with brakes cut out and 1,947 cars with inoperative brakes. It is a matter of common knowledge that these terminal tests on departing trains do not correctly disclose actual operating conditions, for the reason that when the presence of a government inspector is known more than usual care and diligence are exercised in inspecting and testing brakes, as well as in setting out or repairing cars with defective brake equipment. As a result, reports of such tests are misleading and indicate better conditions and practices than actually exist.

In order to obtain a check upon the true condition of air brake equipment in general, tests of trains upon their arrival at terminals have also been made during the past year. In some instances the contrasts between the condition of arriving and departing trains are extreme and striking; for example, in one yard from which trains were departing with 100 per cent operative brakes, trains were arriving with as low as 56 per cent operative brakes. Of course it is as much a violation of law to haul a train into a terminal as away from a terminal with less than the specified minimum percentage of operative brakes or with associated power brakes not used and operated. The law states that it is unlawful to "run any train on its line" without the specified equipment.

The fact that prosecutions have not generally been filed in the past, except in cases where trains have departed from terminals with inadequate brake equipment, does not alter the requirements of law. In connection with these arriving tests, it should be noted that they serve merely to disclose cut out or inoperative brakes; in the reports of these tests there is nothing to indicate whether or not the brakes classed as operative are in effective and efficient condition. Statistics for the first year based upon these arriving tests will not be complete until July, but the results will be set forth in the next annual report of the Bureau, and will probably be published in detail in order to show the actual condition of air brake equipment in use.

It goes without saying that the terminal air brake tests conducted by the railroads, both arriving and departing, should be much more comprehensive and thorough than the inspections and tests made by the government inspectors. The tests made by the government inspectors are designed merely to indicate the general condition of air brake equipment for the purpose of ascertaining whether or not the law is being complied with. No specific method of conducting tests of this nature is prescribed; it is left to the individual inspector to secure the required information, and methods followed vary with locations and operating requirements, as well as with personnel.

It is not my purpose in this paper to enter into a discussion in detail of the methods which should be followed in conducting terminal tests. The results accomplished by these tests constitute the issue of paramount importance, and in each instance the results accomplished as reflected by the condition of air brake equipment should form the criterion by which effectiveness of methods in use is measured.

It is almost trite to say that inspections and tests should be made to ascertain whether all air brake parts and piping are in place, that foundation brake rigging is intact, and that all such apparatus is in operative condition. But it is frequently found in many parts of the country that the inspections and tests made are extremely superficial in character. It is not uncommon to find that no attention whatever is paid to broken retainer pipes or retainers missing or disconnected. Inspections have also indicated the necessity that more attention be devoted to the condition of foundation brake rigging. The need of better maintenance of this equipment is particularly apparent in view of the fact that the foundation brake rigging is an essential part of both the air brake and the hand brake equipment on a car and an inoperative hand brake is a penalty defect. It is the purpose of the Bureau of Safety in future to devote more attention to the condition of foundation brake rigging.

It hardly seems necessary to point out that tests made with yard-line pressure of 90 lb. when the train line pressure used is 70 lb., are not wholly desirable; nor that simply observing that the brake on the last car in a train applies and releases properly is not a proper test of the brake equipment of a departing train; but these conditions have been found to exist in large yards of important railroads.

It has been found that repair work was not being properly done. In one case in the middle west, one of the Bureau's inspectors made an air brake test on a train of 97 cars, in which the brakes on 17 cars were found inoperative, the majority of them being refrigerator cars. The triples on six of these cars bore stencil marks indicating that the triples had been cleaned within a month, but outward appearances led the inspector to believe that no work other than stencilling had been done on them. Subsequently an investigation was made at points where these triple valves had been stencilled and one triple valve was found newly stencilled that had not been cleaned; and on another newly stencilled car the dust collector was full of dirt and corrosion. In another case eight cars were found bearing stencil marks showing that brake cylinders and triples had been cleaned within the last three days. From outward appearances none of these cars had been worked on and three of them were taken down and examined. The brake cylinders and triples were found in a very dirty condition and the examination showed conclusively that no work had been done on them except stencilling. These conditions were traced to their source and corrective measures taken by officials in charge.

It is essential that air brake men be continually on the alert with a view of detecting and correcting improper maintenance and repair work resulting from ignorance, incompetence, lack of proper facilities, or slip-shod methods.

In many locations tests which are intended merely to show that brakes are operative are insufficient to meet operating requirements; it is essential not only to have operative brakes, but also to make certain that the equipment is in effective operating condition, including foundation brake rigging, brake cylinder, triple valve, retaining valve and all piping. Inoperative and ineffective brakes combined have resulted in numerous violations of the air brake law on mountain grades. There are a number of mountain grades in various parts of the country upon which it is common practice to control trains by means of hand brakes, holding the air brakes in reserve and using them only in case of necessity or emergency to supplement the hand brakes. On some grades no other practice has ever been followed. The attention of the commission has been called to the situations in which these unlawful practices exist at various times and

for various specific reasons. In one case an accident resulting from a portion of a train running away on one of these grades was investigated by the Bureau of Safety, and this investigation disclosed that one of the conditions leading up to this accident was the use of hand brakes for the purpose of controlling the train. Proper maintenance of present equipment is all that is required to permit trains to be handled safely on these grades by means of power brakes. And it is in the terminals through which these cars pass en route to these grades that the greater part of this maintenance work must be done. Excessive leakage and defective retainers were among the prevailing conditions which required considerable attention.

The order of the Commission of June 6, 1910, requires that not less than 85 per cent of the cars of a train shall have their brakes used and operated by the engineer of the locomotive drawing the train, and that "all power-brake cars in every such train which are associated together with the 85 per cent shall have their brakes so used and operated."

The minimum percentage requirement of this order is generally understood and recognized, and it is an infrequent occurrence that a train is hauled from a terminal having less than 85 per cent of the cars equipped with power brakes in operative condition. But in addition to the minimum percentage requirement specified, there is also a maximum requirement; the order reiterates the provision of law that all power-brake cars in a train which are associated together with the specified minimum percentage shall have their brakes used and operated. Comparatively little attention has been paid to this maximum requirement, and the belief is widespread and general that if a train has the prescribed minimum percentage of power-brake cars with air brakes in operation, the terms of the law are fully complied with. It is common practice for trains to leave terminals having cars with inoperative brakes, or having brakes cut out, notwithstanding the fact that facilities are available at such terminals for making repairs or replacements necessary to place all power brake equipment in proper operative condition.

Strict observance of the associated car provision of the law, as applied to trains leaving terminals or other points where facilities for making repairs are available, would result in 100 per cent operative power brakes in practically all trains leaving such points. The adoption of this practice would inevitably result in general and material improvement in air brake conditions; careful and thorough air brake tests at terminals would be required, and prompt attention would necessarily be given air brake repairs. The number of violations of the minimum percentage requirement would also be reduced, for the reason that trains now frequently leave terminals with barely 85 per cent of the cars having power brakes in operative condition, and if the brake equipment on additional cars becomes defective en route, or if cars with defective brakes are picked up, or if cars having operative brakes are set out, the train then has less than the minimum of 85 per cent required. This practice would also go far toward meeting the complaint frequently heard that air brake maintenance is neglected on roads where braking conditions are less severe than on roads having steep mountain grades, thereby imposing an excessive burden on the air brake inspection and repair forces of the latter roads.

If required to do so in order to bring about necessary air brake improvements, the Commission can adopt a different policy in the administration of the air brake law, and the existing minimum precentage required can be increased. But it is to be hoped that the railroads themselves are fully alive to the needs of the present situation and will voluntarily take such steps as may be necessary. Proper action by the Air Brake Association and active co-operation of all concerned with these matters will undoubtedly go far toward forestalling necessity for further action in the matter by the Commission.

LOCATION OF BRAKE PIPE ENDS AT THE LOCOMOTIVE PILOT*

By W. W. Wood
Chicago, Indianapolis & Louisville

At the pilot of a locomotive a situation exists in which the recommended practice, as it concerns brake-pipe ends, cannot be adhered to successfully.

The extended pilot, formerly standard everywhere, would not permit the diagonal cross-carrying of the coupled hose when connected with a car ahead or the rear of a leading locomotive, if the pipe end was on the left side of the drawbar. For that reason the pipe ends are commonly found to the right of the drawbar. Here is a condition that provides a brake pipe without lateral deflection from rear to front of locomotive.

But the locomotive builders having located the pipe end 26 in. away from the M. C. B. standard point for cars, have fixed its height from the rail and the distances from the center line of the drawbar shank and pulling face of the coupler knuckle, the same as provided for cars; this brought the terminal angle-fitting too close to the angle cock of the car ahead. Most railroad shops are following this practice.

The result on the Monon was that when the air was coupled to a car ahead, both hose of the connected pair would be crimped and the passage of air restricted. On a double-headed passenger train the air signal and brake equipment of each engine had been tested and found in good condition before leaving the roundhouse. The air piping of the second engine was exactly as it came from the builders and the pipe terminals on the tender of the forward engine were approximately M. C. B. standard in location. After coupling-up, both pairs of hose, brake and signal were crimped so flat that the air signal on the leading engine could not be operated from the cars but would respond to discharges from the pilot hose. The brakes on the cars would apply on a service reduction from the leading engine, but with emergency test from the leading engine, service application only was obtained on the cars.

Recommended practice now extends the brake-pipe ends on certain classes of freight cars much nearer the line of the pulling face of the coupler knuckle than formerly. Two modern, steel freight cars coupled together have their connected hose couplings carried at an angle of 90 deg. to the center line of the car so that they couple exactly crosswise. If such a car were coupled to the pilot of an engine having pipe ends as usually found, the condition should be considered absolutely impossible.

When this subject was brought up at the Central Air Brake Club, some members argued that with the modern receded pilot it would be possible to locate the brake-pipe ends at the left of the drawbar and follow the M. C. B. specifications as to location throughout. This will not hold good on all engines. On the Monon it has been found to be an easy matter to keep the pipe lines on the right of drawbar and obtain an ideal line-up of the hose when coupled forward.

Experimentally, we coupled a locomotive to the rear of a tender having standard pipe-end locations, detached the hose and angle fitting from the brake pipe at the pilot, connected its coupling with that of the tender and screwed a short piece of pipe into the other opening of the angle fitting to represent the brake pipe. Laying this piece of pipe directly on top of the pilot beam and placing its center 13 in. from the center line of the coupler shank, the ideal location was found. In practice we turn the angle fitting slightly toward the center of the track, about 20 deg. from a vertical line through the brake pipe. No attempt was made to standardize this location until we found that it would apply to every class of engine in service on the road.

*Submitted by the Western Air Brake Club.

This might not happen in all cases and the writer recommends that the car piping standards should be generally disregarded in the installation of pipe terminals at the pilot, and the proper locations at the right of the drawbar found for each class of engine.

Discussion

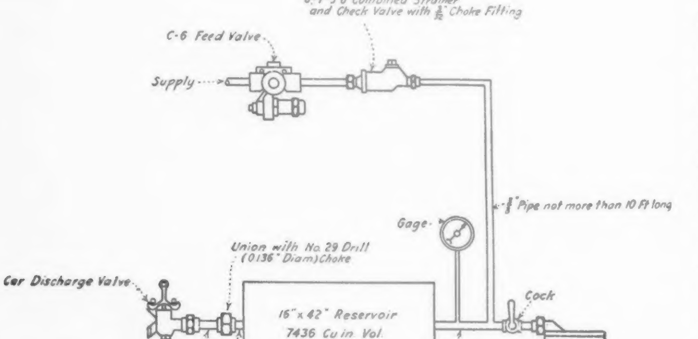
A number of variations in the location of angle cocks and brake pipe ends at the front ends of locomotives were brought out in the discussion. Much difficulty seems to have been encountered in arriving at a satisfactory location of the cut out cocks to meet the requirements of safety and, especially in passenger service, the convenience of the crew when doubleheading. The subject was referred to a committee for investigation and the drafting of a proposal for adoption as recommended practice for the location of brake pipe ends and the location and style of cocks to be used, at the next convention.

AIR SIGNAL VALVE MAINTENANCE*

By James Elder

From the writer's observation air signal valves have not been repaired and maintained as they should be, because air signals failed to respond from rear end cars or gave repeat signals. Where air signal valves are repaired so that they will pass the tests specified they will give good service for the entire period the locomotive is out of the back shop, with the possible exception of renewing the diaphragm. Thus the expensive practice of roundhouse men to keep tinkering with air signal apparatus would be greatly reduced. With the exception of changing a ruptured diaphragm, no other repairs to signal valves should be attempted in roundhouses or small shops. It is needless to say that a sufficient quantity of good repair or new signal valves should be obtained and be accessible for exchange purposes.

The important back shops should be supplied with suitable, inexpensive test racks, to represent the volume and



Rack for Testing Signal Valves in Railroad Shop

resistance of a 15-car passenger train, so that signal valves can be tested while locomotives are passing through the back shops, and no signal valve should be returned to any locomotive if it fails to pass the tests prescribed.

The greatest advantage will be gained by doing extensive repairs to signal valves at only the main shops. When signal valves are found worn or out of standard, and heavy repairs are required to put them in shape, and the valves cannot be repaired so they will pass satisfactorily, it will be to the advantage of the railway to send them to the manufacturer and have them restandardized.

Some of the troubles incident to poor operating signal valves are (a) worn fit of stem and guide bushing, (b) bearing fit of stem in bushing carelessly destroyed by inexperienced workmen, either reducing the stem bearing with a file or mashing it in a vise while holding it to remove the diaphragm; (c) removing the projection at the lower end of the stem by filing it away, (d) facing off the seat at the upper side of the lower cap nut, (e) the use of inflexible diaphragms other than those made especially for signal valves.

The drawing shows the testing device used on several western railways. Any signal valve passing this device can reasonably be expected to operate properly on long passenger trains.

A careful analysis shows that the fit of the stem in the bushing is required to be accurate; that if the stem is too loose the valve will repeat or not give any signal at all; whereas, if the stem is too tight a fit in the bushing, the signal will be too long or be too sensitive to light leakage reductions. The following procedure should be followed in testing the valves, the feed valve being set to maintain 45 lb. pressure and the check valve spring in the combined strainer and check valve reducing the pressure 3 lb.:

Test No. 1—With the whistle valve applied and the system fully charged, open the car discharge valve until the whistle sounds, and then quickly allow the discharge valve to close. As soon as whistle stops blowing quickly open the discharge valve again and so on, in this manner obtaining short blasts of the whistle in quick succession. Five distinct single blasts of the whistle should be obtained in 10 seconds, the time being measured from the instant of first opening the discharge valve, until the instant of opening it for the fifth time. Inability to obtain the five blasts within this time indicates excessive friction between the valve stem and bushing caused by a too close fit.

Test No. 2—With the system fully charged, hold the discharge valve open for 15 to 20 seconds continuously. This should produce one continuous blast of the whistle lasting until a few seconds after the discharge valve is allowed to close. If several short blasts of the whistle are obtained in the test, it indicates that the fit between the valve stem and bushing is too loose.

Discussion

The discussion indicated a general agreement with the author of the paper as to the inadvisability of making repairs to the signal valve in the roundhouse, most of those speaking even condemning the practice of changing diaphragms. The practice of many roads is to return the signal valve to the manufacturer for repair, but it was pointed out that because of the inability to have every valve taken care of in this way, the work done on those handled on the road was likely to suffer because of the lack of proper facilities for doing the work. The inference was that better results would be obtained if each road provided facilities at its principal shop for repairing these valves and handled them all at that point. The difficulty which in some cases has been experienced with rust which accumulates around the valve and its spindle and interferes with its satisfactory operation was mentioned. In the opinion of several members the best solution of this difficulty is to locate the signal valve at a point high enough in the cab to prevent the accumulation of moisture.

Air Consumption of Locomotive Auxiliaries

The committee reporting on this subject through wide investigation has determined that these devices are generally wasting much compressed air. A simple code of tests and condemning limits was proposed, the observance of which may be expected to result in materially improving conditions. An abstract of this report will be found on another page in this issue.

TERMINAL BRAKE WORK FROM THE REVENUE STANDPOINT*

By C. C. Ferguson
General Air Brake Instructor, Great Northern

The investment in all that constitutes a railway is earning just so long as cars are moving toward their destinations. When they are not, it is losing, because interest, wages and

*Submitted by the Central Air Brake Club.

*Submitted by the North-West Air Brake Club.

other necessary expenses are going on. This means that switching, testing air brakes, repairing and other work in terminals are losing revenue. Such delays are necessary, but it is plain that they should be kept as low as possible. The problem is now to test and make necessary repairs in the least time and with the minimum of switching.

Attention is directed to the instructions on Test and Repairs to Brakes on Cars in Terminal Yards, recently made recommended practice by the American Railroad Association, Section III-Mechanical. These instructions are as follows:

INCOMING TRAINS

1. Freight cars in terminal yards should have the air brakes tested as follows:
2. Freight trains, on arrival at terminals where inspectors are stationed to make immediate brake inspection and repairs, shall have slack stretched and left with brakes fully applied in service application. Inspection of brakes should be made as soon thereafter as practicable and any needed repairs made, or promptly mark for repair tracks any cars that cannot otherwise be repaired.

OUTGOING TRAINS AND YARD TESTS

3. While the train is being charged, make a visual inspection of retaining valves and retaining valve pipes, position of angle cocks and hose, and examine closely for leaks from the brake pipe and its connections, and make necessary repairs to reduce this leakage to a minimum when the brake system is charged to standard pressure.
4. When the brake is charged to standard pressure, make a 15-lb. service reduction, after which a second examination of the train should be made to determine:
   (a) Brake pipe leakage.
   (b) If triple valve will operate on service application.
   (c) Piston travel.
   (d) Brake cylinder leakage.
   (e) If the brakes release properly.
5. If, during this test, the brake pipe leakage, as indicated by the brake pipe gage, exceeds 8 lb. per minute, it should be reduced to 8 lb., preferably 5 lb., and if piston travel is less than 6 in. or more than 8 in. it should be adjusted to 7 in. All defects found shall be repaired in the yard or car sent to shop or repair track for necessary attention.
6. In addition to the above terminal tests, at last terminal inspection point prior to descending mountain grades, it must be known that a sufficient number of retaining valves are in good operating condition to control the train.

The Incoming Test

Normally and properly the first thing done to an incoming freight train is to make the general inspection. Here we have dead time that, by means of incoming brake test, should be utilized to locate air brake defects so that such as are heavy may be marked for the repair tracks before switching is done and all available time employed for repairing the others.

But the time and a half for overtime since allowed to freight train men, and insufficient consideration given to certain features of the recommended practices warrant some changes in the foregoing.

Several of the roads represented in the North-West Air Brake Club have long since demonstrated the practicability and value of the incoming brake test. In fact, the Soo Line is undoubtedly the pioneer in making this test, with the Northern Pacific a close second. This is mentioned merely that due weight may be given to recommendations based on long experience. The first recommendation is that paragraph 2 in the foregoing be changed to read as follows:

2. The incoming air brake test should be made with all arriving freight trains and transfers, and to permit of this the incoming crews shall leave the brakes fully applied from standard pressure by a service reduction or reductions totaling 20 lb. Inspection of the brakes should be begun immediately and completed within 20 minutes, confining it to observance of piston travel, brakes that do not apply or that leak off and to other observable leakage, and quickly indicating defects found by suitable chalk marks. On completion of this inspection make indicated repairs or mark cars for the repair tracks, as the circumstances require.

The advantage of having the slack stretched while inspecting draft rigging and air hose is recognized, but to do this in an effective way will require, after the stop, releasing the air brakes, applying rear hand brakes, pulling out the slack, fully recharging and reapplying the air brakes, and an attempt to include it would increase the amount of overtime and would decrease the reliability of the incoming brake test.

The present reading of paragraph 2 discourages the incoming test, first, by the qualification, "where inspectors are stationed to make immediate inspection and repairs"; and, second, by stating that, following the application of the brakes, inspection "should be made as soon thereafter as practicable." This inspection is mainly to determine whether the brakes are reasonably efficient, and it will assuredly be granted that a brake which has not leaked off in 20 minutes will meet with this requirement. To appreciably extend this inspection time is unwarrantedly to delay traffic and increase expense, as it will send cars with reasonably efficient brakes to the repair tracks. The alternative is that inefficient brakes will not be detected.

Should it be desired to provide for the alternative of an incoming brake test being made by the slower and more cumbersome use of a yard testing plant, which we do not favor here, it should be cared for by a separate paragraph.

The recommended change in paragraph 2 refers to "standard pressure," understood for freight to mean 70 lb., and attention is called to the fact that if the test is made from a higher pressure it will pass some defective brakes as satisfactory because of the greater amount of auxiliary reservoir air to be leaked away. Hence, if any road is using a higher brake pipe pressure on any moving trains, it is recommended that it be reduced to 70 lb. (by applying and releasing) before making the test application.

The Outgoing Test

The haste more or less incident to the outgoing terminal brake test referred to in paragraph 4 will often result in the application being made before some brakes are fully charged. Hence, a reduction of 15 lb., with long trains, will result in some brakes failing to apply or hold long enough for the inspection which would be found satisfactory if they had been charged or if the reduction had been 20 lb.

The desire to combine with this test a fairly satisfactory measure of the rate of brake pipe leakage is appreciated and no recommendation for a change is made at this time.

Clause (e) is a detail which cannot be determined while brakes are applied, as here stipulated. While the object will doubtless be generally understood, the wording of this paragraph could advantageously be changed to make the meaning clearer.

R. H. Aishton's circular 95 of January 8, 1920, dealing particularly with avoiding delays at terminals, in order to lessen time and a half for overtime, suggests for each important yard the need of a yard plant for testing the outgoing train before the engine is applied. This is approved, but with the distinct understanding that it cannot accomplish the needed results unless the incoming test is made; also, that to realize its value sufficient inspectors must be available who must receive prompt notice when a train is ready for them, so as to avoid wasting time waiting for it to be made up or being late because of not knowing it was ready for them. This is not the time nor the place to make other than the lightest repairs, mainly stopping brake pipe leaks. In fact, if the incoming test and indicated repairs have been made as they should be and if inspectors are promptly advised when each train is made up, the character of the remaining work, including the outgoing terminal brake test, will usually be such as to enable the despatcher to figure quite accurately as to when a train will be ready. The outgoing crew would then find the train tested and charged and requiring no more brake work on their part than making the brake pipe test from the engine immediately after attaching it. If operating departments really propose to provide and make use of outgoing yard brake charging and testing plants, it would be well to add to the recommended practice instructions to cover their use.

As the detailed instructions governing the making of the incoming brake test can largely influence the results obtained we submit the following as in effect on one large road: "Enginemen and trainmen of freight trains on arrival at terminals will leave the brakes applied by a 20 pound service reduction made from 70 pounds. Where

engineman has made an automatic application for stopping he will as soon as stopped, add to it by one farther, continuous reduction sufficient to make a total of 20 pounds, and watching the gage, insure that this amount is had when the brake valve discharge ceases. On its completion he will give one short whistle blast as advice to brakeman that he may cut off and to inspectors that inspection may begin. The brakeman will not close angle cocks until this signal is given.

"When the train must be left on two or more tracks, or when crossings must be cut, those concerned will follow the foregoing plan before cutting off each part.

"To avoid preventing inspectors from ascertaining the condition of air brakes, switchmen, carmen and others must not discharge any air from the auxiliary reservoirs or brake pipe of cars that have not been inspected. Before discharging any air from those already inspected an angle cock must be closed between such and any uninspected brakes.

"On brakes being applied, as indicated by whistle signal, inspectors will at once and rapidly examine for piston travel, brakes failing to apply, any that have leaked off and brake pipe leaks. At this time, make no repairs; merely indicate the defects with chalk. After completing inspection repair the defects that should be cared for in the yard. For other defects bad-order cars for repair tracks, unless impracticable, as may be with time freight. The air brake and the general inspection must not be made by the same man or men.

"Adjust incorrect piston travel (less than 6 inches or over 8 inches) to 7 inches. Consider cars over 12 months since brakes were cleaned as having defective brakes. Loads that cannot be held for brake repairs earlier will, where destination is a terminal, be marked on arrival "BO when empty," with date, and defect. These will be delivered to repair tracks as soon as practicable after unloading."

Discussion

The discussion covered the whole field of freight brake conditions, which all have a bearing on the difficulties of getting trains out of terminals with brakes in condition to meet the requirements of the safety appliance law without excessive terminal delays. The discussion indicated clearly that freight brakes generally are in an unsatisfactory condition from the service standpoint and that this condition is not due to any one cause, but to a large number of causes. Some of the causes mentioned were undesired emergency brake applications, excessive brake pipe leakage, careless and unskilled workmanship in maintenance, neglect of maintenance, inadequacy of the customary type of attachment for brake cylinders and auxiliary reservoirs, retention in service of worn-out brake cylinders in which tight packing leathers are an impossibility and a lack of appreciation and indifference of the managements to the resulting loss in operating efficiency. That a high standard of brake maintenance is not only possible but practicable was indicated by the experience of several roads operating with a high percentage of their own equipment which is retained and maintained at home. Several instances were given where railroads regularly send trains, in some cases with as many as 90 to 100 cars, from terminals with not more than two or three pounds per minute brake pipe leakage, and one instance was mentioned where such a train, departing from the initial terminal with a leakage not to exceed three pounds per minute, arrived at the end of a 125-mile run and when tested showed but four pounds per minute brake pipe leakage.

That when once placed in good condition, the maintenance of a high standard of freight brake conditions is not a difficult matter was evidenced by the experience of the Duluth, Missabe & Northern, which was mentioned several times by members from other roads as having exceptionally good brake conditions. With a total of 7,000 cars in regular freight service on this line, it was necessary to set out on account of brake conditions but four cars in a period of twelve months, and these were due to leaky cylinder packing leather caused by over travel of the piston in connection with a failure of the foundation brake gear. From an initial brake cylinder leakage of three pounds per minute, 2,000 cars after 24 months' service without cleaning had developed cylinder leakage not exceeding four pounds per minute maximum. Other roads reported as high as from 10 to 20 per cent of the brakes tested requiring recleaning in from one to three months following the last cleaning date.

The inability of the Air Brake Association alone to remedy these conditions because of the possible terminal delays and initial expense required to bring about a countrywide improvement of these conditions, was touched on several times. The value of the incoming test in this connection was dwelt upon because of the possibility of reducing terminal delays chargeable to brakes by utilizing the dead time during the general inspection of the train to make needed repairs. A significant point was brought out in connection with the establishment of the incoming test on one road where it has been in effect for a number of years. Some difficulty had been experienced in convincing the management of the desirability of the test, as the time available resulted in doing much more work than is usually permissible following the outgoing test. It was found, however, that an appreciable credit balance resulted from the charges against other roads for the extra amount of work done, and the presentation of this fact to the management secured approval for the establishment of the incoming brake test.

The convention voted to refer the subject to a committee with instructions to investigate general conditions, formulate recommendations and present data as to possible savings from a revenue standpoint from the establishment in practice of the recommendations.

Other Papers and Addresses

The St. Louis Air Brake Club submitted a report on "Changes in the H-6 Brake Valve," signed by W. H. Davies, R. E. Wark, and F. V. Johnson, which outlined a method of making the changes in existing brake valves that are now incorporated by the manufacturer in new valves. An illustrated lecture on "Modern Trains and the U. C. Equipment," by J. C. McCune, was submitted by the Manhattan Air Brake Club.

During the course of the convention, the association was addressed briefly by W. H. Winterrowd, chief mechanical engineer of the Canadian Pacific, and F. W. Brazier, assistant to the general superintendent of rolling stock, New York Central. R. I. Cunningham of the Westinghouse Air Brake Company, gave a very interesting talk on air brake conditions in France.

Business

An invitation from the American Railroad Association, Section III-Mechanical, to affiliate as a division of that organization was brought before the association and referred to a committee, which drafted a tentative set of by-laws designed to protect the interests of the association membership as it is now organized, in the event of affiliation. The matter was finally referred to the executive committee with instructions to conduct negotiations with Section III-Mechanical and report to the association at the next convention for action by the members.

The following officers were elected for the ensuing year: President, L. P. Streeter (Illinois Central); first vice-president, Mark Purcell (Northern Pacific); second vice-president, George H. Wood (A. T. & S. F.); third vice-president, E. M. Kidd (Norfolk & Western); secretary, F. M. Nellis (Westinghouse Air Brake Company); treasurer, Otto Best (Nathan Manufacturing Company). W. W. White (Michigan Central) was elected a member of the executive committee to fill the vacancy created by Mr. Kidd's election as third vice-president.

View of Inspection Shed and Accumulated Car Wheels

ECONOMIES POSSIBLE BY CAR WHEEL GRINDING

The Field for Effective Car Wheel Grinding Includes New and Old Cast Iron and Steel Wheels

WHILE an exhaustive study of car wheel grinding is impossible within the limits of this article, certain convincing data are presented which proves the possibilities of the practice. Not only have cast iron wheels with slid flat spots been reclaimed by grinding, but important railroads in different parts of the country have found it profitable to grind the treads of new cast iron and cast steel wheels, these being used in light passenger service and under light weight box cars, refrigerators and caboose cars.

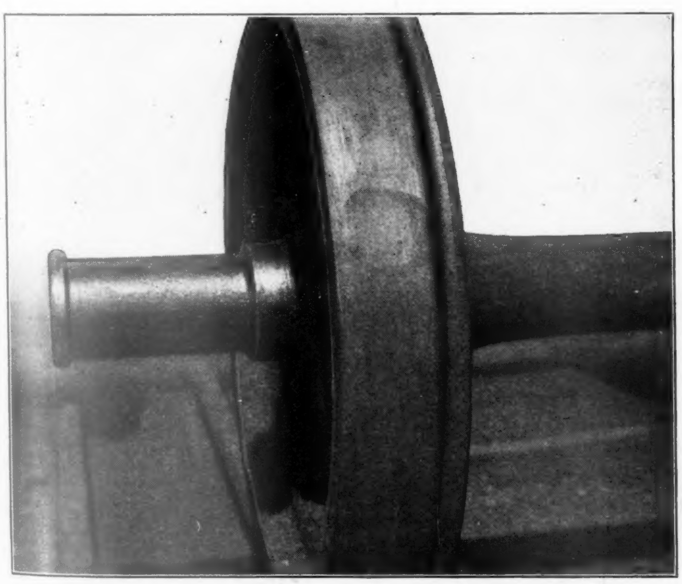


Fig. 1—Type of Flat Spot Removable By Grinding

Besides the need for a more general installation of car wheel grinders in railway shops, it is apparent that those machines already installed should be used to their utmost capacity. In fact, the crux of the matter lies right there. With a net profit of $6.05 on every pair of cast iron wheels reclaimed by grinding, any railway shop can afford the installation of a grinding machine, provided enough slid flat wheels come to that point to keep the machine busy eight hours a day. In case enough slid flat wheels are not available, the machine can be kept busy grinding new wheels.

The car wheel grinding practice most commonly known consists of grinding flat spots out of chilled cast iron car wheel treads. Obviously, the thickness of chill is greater on a new wheel than on one with a heavy mileage, and the length of flat spot that can be ground out without getting through the chill is, therefore, relatively greater. The minimum depth of chill at the middle of the tread of a good quality wheel is ½ in. and, while common practice limits the length of flat spots removable by grinding to 3½ in., some authorities maintain that this limit should be increased to 4 in. or 5 in. On a 33-in. wheel, 3½-in. and 5-in. flat spots represent depressions of .095 in. and .190 in., respectively, which leaves a considerable depth of chill after grinding. The kind of flat spot removable by grinding is shown in Fig. 1, while Fig. 2 shows a pair of wheels after being ground.

In addition to reclaiming cast iron wheels with flat spots, it has proved desirable to grind cast iron passenger car wheels when newly applied and before being put into service. One of the leading railroads in the east has followed this practice for a considerable period of time and finds that when the tread of a wheel is once ground smooth, round and concentric with the journal, there is a material increase in the actual ton mileage. In addition, flange wear is reduced to a minimum by having true wheels of equal diameter on the same axle. For suburban passenger service especially, ground wheels are desirable because the treads are then concentric with the journals, and the whirring sound due to raised chill marks is eliminated.

While most roads turn their wrought steel tired wheels, grinding presents a possibility of saving service metal because it is not necessary to take a heavy cut to get under the hard skin on the treads. The controlling feature as to grinding or turning wrought steel wheels with flat spots is

the condition of wear of the flanges. With the cast steel wheel, however, especially one with a high proportion of manganese in the tread, the car wheel grinding machine affords the only means of securing a smooth wheel tread without eccentricity.

An example of the type of machine developed for car

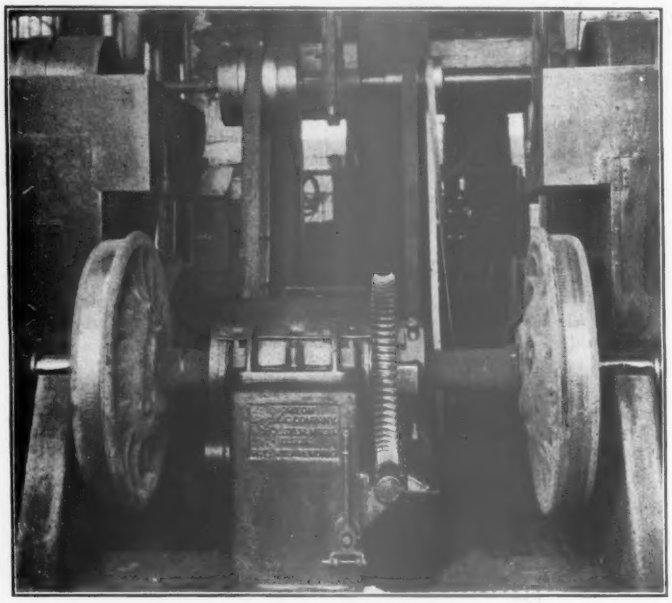


Fig. 2—Car Wheels Just After Being Ground

wheel grinding is illustrated in Fig. 3. It can be used to grind car wheels up to 44 in. in diameter, and engine truck wheels up to 36 in. in diameter. Since the wheels are ground without being removed from the axle, the machine is designed for standard 4-ft. 8½-in. gage, and cannot be changed for other gages. Two grinding wheels of 24-in. diameter and 2¾-in. face are used with the machine, and are adapted to grind either steel or chilled cast iron wheels. Driven by a 35-hp. constant speed motor, the machine has ample power to remove metal quickly, and the production is materially increased by a pump and water tank arrangement, furnishing 40 gallons of water per minute on grinding wheel.

Chilled Cast Iron Wheels

The number of chilled cast iron car wheels reclaimed by grinding at any one point varies greatly from time to time and with the season of the year. For example, it has been noticed that much more slipping, with resultant flat spots, occurs during the winter months than during any other time of the year. The number of flat spots developed during the spring and summer months, however, is large. In March of the present year, 1,200 cast iron wheels were sent to the scrap dock of the eastern railroad previously referred to, and 10 per cent of these were reclaimed by grinding. It is felt that many shops not now equipped with car wheel grinding machines are unable to take advantage of a large possible saving. While interchange rules do not provide for the removal of wheels with flat spots under 2½ in. long, a large number of flat spots over that length develop. In addition, a careful inspection of the scrap pile indicates that inspectors are condemning many wheels that could be reclaimed by grinding.

TABLE I—TIME REQUIRED TO GRIND FLAT SPOTS OUT OF CHILLED CAST IRON CAR WHEELS

Car wheel, pair, No.	Time of set up, minutes	Grinding time, minutes	Total, minutes
1	10	30	40
2	10	39	49
3	10	17	27
4	10	27	37
5	10	25	35
6	10	40	50
7	10	15	25
8	10	28	38
9	10	25	35
10	10	16	26
11	10	26	36
12	10	21	31
13	10	24	34
14	10	34	44
15	10	30	40
16	10	38	48
17	10	16	26
18	10	42	52
19	10	14	24
20	10	45	55
21	10	24	34
22	10	17	27
23	10	30	40
24	10	18	28
25	10	16	26
26	10	50	60
27	10	35	45
28	10	37	47
29	10	30	40
30	10	40	50

Average time = 38 minutes

To estimate the actual saving effected by grinding out the flat spots in chilled iron car wheels, the data shown in Table I were obtained in a trial test. The average time of setting up the pair of wheels in the grinder was 10 minutes,

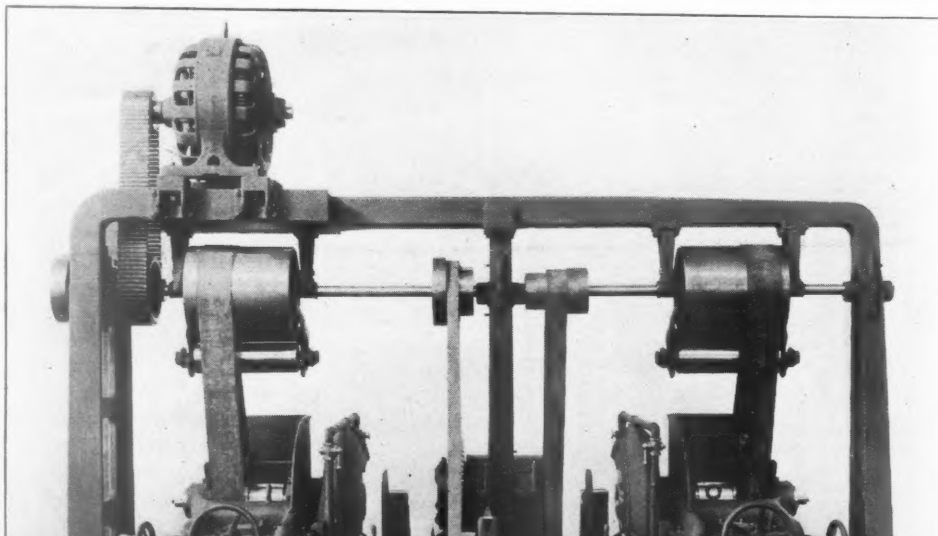


Fig. 3—Machine Developed for Grinding Mounted Car Wheels

and the grinding time varied from about 14 to 50 minutes, depending upon the condition of the wheel tread and the length of the flat spot. As indicated, the average total time required to grind each of 22 pairs of wheels was 38 minutes.

The saving effected, as shown in Table II, was computed by obtaining the difference between what it would cost to apply a new wheel and the cost of grinding flat spots out of the old one. It is obvious that the cost, in the case of a new wheel with a newly developed flat spot, includes the difference between its new and scrap value, plus the cost of removing, boring and applying the new wheel. This total figure is $7.55, as indicated. Most manufacturers offer a differential of $1.05 per hundred pounds, but in the present calculations the M.C.B. differential of $7.25 for a 33-in. wheel is used. The labor charges represent a relatively small proportion of the total, and the total figure is conservative, because of the assumption that only one wheel develops a flat spot, whereas the more common experience is to find a flat spot on both wheels mounted on the same axle. The saving will of course vary with the probable service life of the wheel depending on the amount of tread or flange wear existing at the time the flat spot develops.

TABLE II—SAVING EFFECTED BY GRINDING FLAT SPOTS OUT OF CHILLED CAST IRON CAR WHEELS

Cost of applying new wheel:		
M. C. B. differential on 33-inch wheel	$7.25	
Charge for removing old wheel	.09	
Charge for boring new wheel	.12	
Charge for pressing on new wheel	.09	
Total		$7.55
Cost of grinding out flat spots:		
Labor per pair, at .72 an hour	$0.46	
Power per pair, at .02 a kw. hour	.28	
Grinding wheels, per pair	.15	
Interest at 6 per cent	.23	
Depreciation and repairs at 10 per cent	.38	
Total		1.50
Total saving per pair		$6.05

The first item to consider in the cost of grinding out flat spots is the labor charge. As shown in Table I, the average time required for grinding, including the time necessary to place the car wheels in the machinne, is 38 minutes. In most shops the man who operates this types of machine receives 72 cents an hour, which, for a period of 38 minutes, is 46 cents. It is estimated that the machine at normal load consumes about 30 kw. at a rate of two cents a kw. hour, but the power is not on during the time of setting up. Therefore, the total cost of power per pair of wheels is:

$$30 \times \frac{38 - 10}{60} \times 2 \text{ cents, or 28 cents per pair.}$$

A very important item in operating efficiency is the selection of a suitable grinding wheel. It is possible that a certain grinding wheel can be chosen, which will grind as many as 800 wheels, but the results both as to production and quality of work are not nearly as satisfactory as when a softer grade of wheel, which will grind possibly 200 wheels, is used. If grinding wheels cost practically $30 a piece and last to grind 200 wheels, the cost of grinding wheels per pair of car wheels ground is 15 cents, as shown.

TABLE III—TIME REQUIRED TO TRUE UP NEW CAST IRON WHEELS BY GRINDING

Car wheel, pair, No.	Time of set up, minutes	Grinding time, minutes	Total, minutes
1	10	10	20
2	10	8	18
3	10	8	18
4	10	8	18
5	10	8	18
6	10	10	20
7	10	9	19
8	10	7	17
9	10	10	20
10	10	10	20
11	10	10	20
12	10	8	18
13	10	10	20
14	10	9	19
15	10	8	18
16	10	7	17
17	10	9	19
18	10	10	20
19	10	9	19
20	10	10	20
21	10	9	19
22	10	8	18

Average = 19 minutes

Interest charges at six per cent per annum on an investment of $15,000 (the cost of the machine) amount to 23 cents per pair of wheels. This figure is obtained by assuming an eight-hour day, and a time of grinding of 38 minutes. It is obvious that a high priced machine must be kept busy as much as possible to reduce the overhead charges, and in shops which are working two shifts, the interest charge on the investment is reduced one-half.

The depreciation and repair charges, shown in Table II, are estimated on a 10 per cent per annum basis and amount to 38 cents per pair of wheels. The total cost of grinding, then, amounts to $1.50 per pair of wheels. This cost is nearly three times as great as that computed on page 406 of the 1917 volume of the *Railway Mechanical Engineer*. Attention is called to the relatively large proportion of the charges for interest and depreciation, elements which are too often neglected in estimated savings. With the present cost of modern up-to-date machinery, these items must be carefully considered and every effort made to use the machines to their utmost capacity; otherwise, it is impossible to show a net profit in operation. Inasmuch as the cost of shipping flat wheels to the grinder will about equal the cost of shipping new wheels, the total saving for each new wheel is $6.05, as shown in Table II, and the only requirement necessary to make a car wheel grinder earn a profit is to see that sufficient wheels are received to keep the grinder busy eight hours a day.

New Cast Iron Wheels

The idea of grinding new cast iron passenger car wheels on the tread to insure the treads being accurately round and concentric with the journals, has been tried and proved good practice. When new wheels are ground in this way, there is an error not exceeding .002 in. or .003 in. from a perfect circle, and this insures a smooth riding wheel on which the brake shoe is not likely to stick. The grinding times on a lot of 22 new chilled cast iron passenger car wheels are shown in Table III. As in the previous tests, the time of set-up is estimated at ten minutes and the total average time of grinding is nineteen minutes.

TABLE IV—DATA SECURED IN GRINDING NEW CAST STEEL CAR WHEELS

Diameter of grinding wheel, inches	Car wheel size, inches	Depth of cut, inches	Net grinding time, minutes
23¾	33	....	14.50
	33	....	8.66
	33	....	7.16
	33	....	7.00
	36	....	9.31
	36	....	10.32
	36	.080	.....
	36	.065	13.00
	36	.031	9.24
	36	.028	7.66
	33	.068	6.00
	33	.051	8.00
22	33	.056	7.32
19 3/16	36	.118	9.16
	36	.032	11.00
	36	.090	6.32
	36	.110	8.00
	33	.090	15.00
	33	.045	9.32
	36	.150	11.50
	36	.043	5.16
	36	.085	5.50
	36	.041	4.00
	36	.070	2.32
17¼	36	....	11.50

Average time = 8.62 minutes

Inasmuch as the benefits of grinding new car wheels are nearly all indirect, there is no good method of estimating the saving, but several important roads have given the practice a thorough try-out and found it economical in the long run and satisfactory. Thus far very little grinding of car wheels, except in the passenger department, has been done.

New Cast Steel Car Wheels

In the grinding of steel car wheels, new factors enter into consideration. For example, steel tired wheels can probably be placed in a wheel lathe and turned at a cost not much greater and in no longer time than would be required to grind the wheel treads. A new flange contour would be obtained but at the expense of service metal since a grinding machine does not need to cut under the hard surface skin on the tread. With the cast steel car wheel, however, especially one having a manganese tread, the pendulum again swings in favor of the car wheel grinding machine as a method af truing the wheel tread and making it both round and concentric with the journal. Attention is called to Table IV, which shows the data secured in grinding 25 pairs of steel wheels. The average grinding time was 8.62 minutes, which, added to 10 minutes, the time of set-up, gives a total time of 18.62 minutes. In other words, there is little difference in the length of time required to grind either the cast iron or cast steel car wheel. Additional information secured in this test shows the reduction in grinding wheel diameter as the work progressed, also the depth of cut which varies from .043 in. to .150 in.

Conclusion

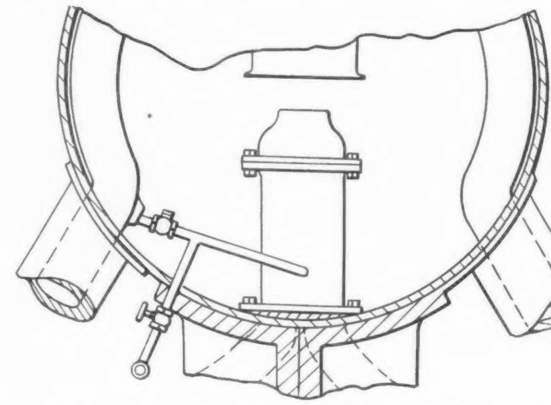
To summarize the results of tests mentioned in this article and the experience of important roads in different parts of the country, it has been demonstrated good practice to reclaim cast iron car wheels with flat spots up to 3½ in. long, provided the wheel has not made too great a mileage. The economy of the practice also depends on finding enough wheels to keep the grinder busy the full working day. Twenty-four pairs of new cast iron passenger car wheels can be ground in an eight-hour day and actual experience has demonstrated that these wheels should unquestionably be ground before use to insure a round, smooth tread, concentric with the journal. Extension of the grinding practice to new freight car wheels depends on whether the decreased flange wear, due to heavy wheels of equal diameter, would make it pay to grind mated wheels of the same taper size. That it is possible to grind steel car wheels, has been demonstrated beyond a question of doubt, but in actual practice it is probable that the grinding method can be more profitably used in the case of a cast steel wheel rather than a wheel with wrought steel tires. The manifest advantages of grinding car wheels in general have been appreciated and taken advantage of by leading trunk line railroads, and it is reasonable to believe that many smaller roads could benefit by the practice.

EXHAUST PIPE VALVE

Some months ago the Ann Arbor Railroad put into use an exhaust pipe actuated by fluid pressure, as shown in the illustration, and at the present time this railroad is having two locomotives built by the American Locomotive Company at their Dunkirk works that will be equipped with exhaust pipes of this design.

By referring to the illustrations of this device it will be seen that when the throttle valve is open steam is supplied to the connection, furnishing pressure required for the operation of the exhaust pipe valve. When vacuum relief valves are used air is admitted to the cylinder in the usual way, and no gases or cinders are drawn into the valve chamber from the smoke box. When vacuum relief valves are not used, and while the reverse lever is in the direction of movement of the locomotive, the cylinders are converted into vacuum pumps, which action works as a vacuum brake tending to retard the movement of the locomotive.

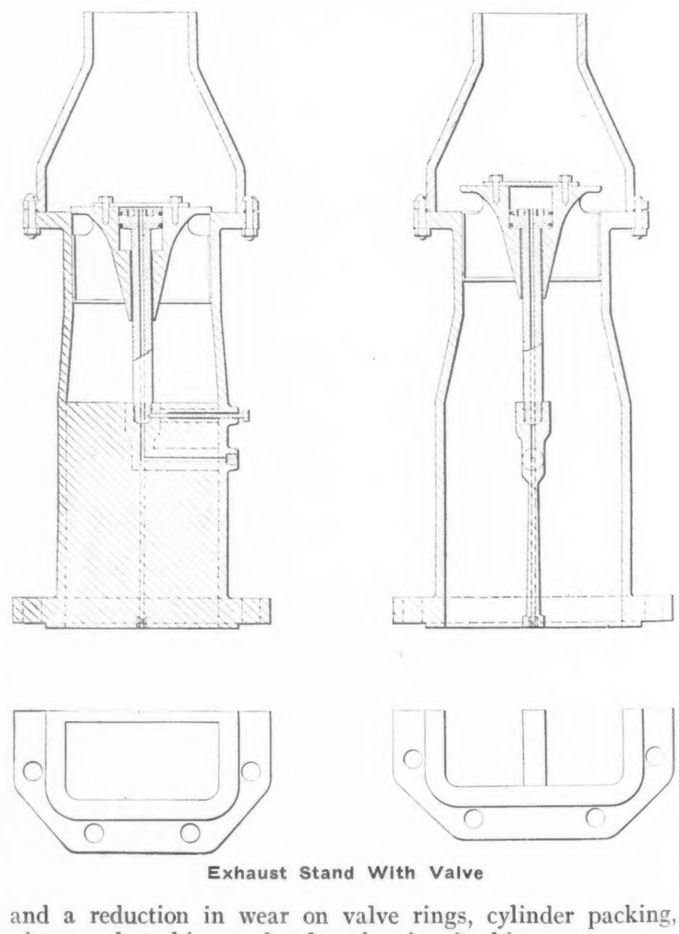
When relief valves are used and the reverse lever is placed in the opposite direction to the movement of the locomotive, the cylinders act as air compressors and the air reservoir may be charged automatically with compressed air without the possibility of drawing any fine particles from the smoke box that might be considered detrimental to the air-brake mechanism. If the locomotive is handled dead in a train a separate connection is provided to the passage leading to the exhaust pipe valve, which may be connected to the brake system so that when charged the exhaust valve will be held off its seat



Arrangement of Pipe Connecting to Exhaust Stand

and the locomotive may be moved in either direction without difficulty.

This exhaust pipe valve is the invention of J. E. Osmer, superintendent motive power of the Ann Arbor Railroad, who has applied for patents covering the device. It is claimed that its use will result in a considerable saving in valve oil



Exhaust Stand With Valve

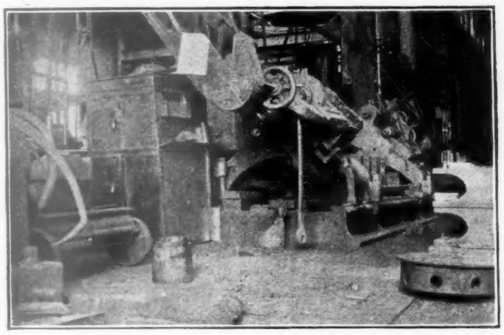
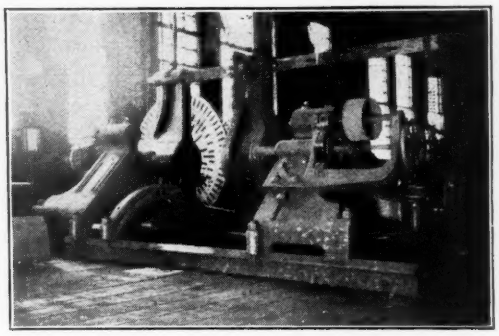
and a reduction in wear on valve rings, cylinder packing, piston rod packing and valve chamber bushings.

It is further stated that this exhaust pipe valve is particularly applicable to locomotives operating over heavy grades, where they are required to drift for long periods, causing the steam passages to become clogged with carbon and particles from the smoke box.

RAILROADS NEED MODERN MACHINE TOOLS

More Critical and Scientific Attention Must Be Given to the Upkeep of Cars and Locomotives

BY ROY V. WRIGHT
Editor, Railway Mechanical Engineer


Nobody Knows How Old They Are

THERE is no question about the seriousness of the transportation problem. Production is today greatly restricted because of the lack of adequate transportation facilities, coupled with the fact that the existing equipment is not being used with the greatest possible efficiency.

There are very good reasons for the situation in which the railroads now find themselves. In the first place, for the early part of the year up to the time of the outlaw strike, the roads handled more traffic than ever before in a corresponding period. More traffic is being offered to them now than ever before. In the second place, the roads found it necessary during the war to work their facilities and equipment to the very limit, and because of this and the lack of labor and material they naturally were unable to maintain their properties in the best condition. In the third place, there was very great uncertainty until the last moment as to just when the roads would be handed back to their owners and under what conditions. It was, therefore, of course, impossible for the managements to make the necessary contracts for the new equipment and facilities which are so greatly needed at this time. Indeed, even today they are more or less at sea as to how to finance themselves except for a few of the more prosperous roads. The Pennsylvania, with its splendid property, had to pay 7½ per cent on its $50,000,000 bond issue, and yet this sum covers only a small part of its needs. Congress has provided a revolving fund which is not at all adequate so far as meeting the present needs of the railroads is concerned, and which cannot be made use of by the weaker roads because they are unable to furnish the right kind of security.

Fortunately, Congress and the public at large are thoroughly aware of the necessity of restoring the credit of the roads so that they will be in a position to finance themselves in the future. The extent to which credit will finally be restored will depend upon how fully the enlarged and reorganized Interstate Commerce Commission will discharge its responsibilities in seeing that the roads are given adequate rates and that the Transportation Act is interpreted in such a way as to develop rather than restrict the activities of the roads.

Even those roads which have ordered equipment are being embarrassed because they went into the market so late that the other industries beat them to it, and in many instances they will have difficulty in getting early deliveries unless some sort of priority arrangements can be agreed upon. What good will it do the industries if they secure material which is needed by the railroads, and which, if assigned to the railroads, would enable them to increase their capacity so that they could handle a larger part of the output of the industries.

So much for the problem in the large.

Better Use of the Equipment

There are many ways in which better use can be made of the equipment and facilities which the railroads now have. Shippers can cooperate to a very much greater extent than they are now doing in the prompt loading and unloading of cars. Splendid cooperation was given during the war, but since the signing of the armistice much less interest has been taken by many of the shippers. It is now more than ever necessary that the cars be loaded to their full capacity and that they be loaded and unloaded as quickly as possible. The Interstate Commerce Commission will undoubtedly take steps to inaugurate practices which will be helpful in this direction, but it will also be necessary to secure and retain the hearty and cordial interest of the shippers.

The railroad managements must do their full part in getting better use from the facilities and in increasing the efficiency of operation. With the present labor conditions this will be a most difficult task. The men believe that they have not been treated rightly as to compensation, and are more or less impatient with what they believe to be the slow progress on the part of the Labor Board which was provided by the Transportation Act. Naturally they are not doing their best work. On the other hand, they must undoubtedly be awakening gradually to a realization of the fact that the slackening up of their efforts is an economic waste, and that it is forcing living costs higher and higher. The managements must not only win them over and get them to see the problem in the right light as related to the good of the country as a whole (and therefore themselves), but they must adopt an aggressive program to train and develop the new and inefficient men that they have had to employ to replace those skilled men that have been taken away from them by the industries which could afford, or felt they could afford, to pay much more for the services of these men than could the railroads.

*An address before the National Machine Tool Builders' Association at Atlantic City, N. J., May 20, 1920.

Cars and Locomotives Must Be Kept Fit

Railroad managements learned a most severe lesson when they tried to handle the tremendous increase in traffic after our country entered the war. They learned that no road could work efficiently or anywhere near its capacity unless the cars and locomotives were maintained in first-class operating condition. Under-maintenance and weak equipment mean breakdowns on the road, delays to traffic, damage to freight, and abnormal increases in the cost of operation. The thing that today is necessary more than anything else is that the roads should concentrate upon the care and maintenance of their cars and locomotives in order to get the very best possible returns from such labor and the small amount of money which is now available. This means that the weak spots must be located and strengthened one by one in order that the effectiveness of the transportation machine as a whole may be developed to the highest possible point.

Here is where we get down to the necessity of making a most critical analysis of the machine tools and equipment in all of the shops and engine houses on every road. The financial resources of the roads at this time are such that it will be foolish and ridiculous to expend in a haphazard way any money for equipment or facilities. Every cent must be scientifically placed where it will do the greatest possible amount of good.

What Machine Tools Are Needed Today?

It is impossible to make any accurate general statement as to the present condition of the machine tools on the railroads. With the assistance of the Railroad Administration, some of the roads on which conditions were particularly bad during the war were enabled to add a considerable number of new tools; other roads whose needs were not so pressing have had to discontinue their regular programs of improvement and their equipment is today considerably below what would have been its normal condition had it not been for the war.

Frank McManamy, assistant director, division of operation, United States Railroad Administration, in speaking before the New England Railroad Club six months before the end of government control said: "The use of out-of-date tools and machinery in railroad shops—although never satisfactory—may have been in the interests of economy at the rates paid for labor before the war, but under the rates now paid the use of inefficient machinery is not only unsatisfactory but decidedly expensive. I shall not specifically refer to conditions in the different shops at the time the railroads were taken over by the government, but it is a quite well-known fact that many of them, together with their equipment, were at that time and are today almost hopelessly out of date in the matter of buildings and equipment, and that the methods which this lack of facilities make necessary are such that no manufacturing industry operated on a competitive basis could exist under. In fact, it has been stated, and with considerable justice, that $10,000,000 spent for shops and shop machinery prior to 1917 would have made it unnecessary for the government to have assumed control of the railroads. Whether or not this statement is true, it is a fact that one of the principal reasons—if not the principal reason—for taking over the railroads was the condition of locomotives and cars in certain sections of the country which, together with insufficient terminal facilities and the effort of many shippers to use the cars as storehouses, caused such a congestion that nothing short of centralized control with complete authority could have met the situation."

Some railway mechanical departments have always had a keen appreciation of the value of keeping the machine tool and other shop facilities up-to-date and in first-class condition, and have been able to secure the approval of their managements to such programs. Other roads, because of financial conditions or lack of vision on the part of their managements, or a combination of both of these factors, have struggled along with old inadequate equipment, and whether they realize it or not have had to pay a mighty high price for so doing.

I know of one important road which has always given careful attention to its machine tools and has replaced old tools or added to the equipment whenever it appeared to be wise to do so. This road has the reputation of maintaining its cars and locomotives in the best possible condition, and such statistics as are available would appear to justify this course by the lower cost of operation and the better use which is being obtained from the equipment. On the other hand, I know of another large road which has purchased practically no machine tools for ten years. There are not a few shops in the country that have a large number of tools which can best be described by the use of the words "ancient" or "antique."

In general it is safe to say that there are very few roads that are not today in need of a considerable number of new tools, while many of the roads ought, in the interests of efficiency, to make very heavy expenditures for machine tools and shop equipment. The *Railway Age* in an article in its January 2, 1920, issue showed as a result of an extensive and careful study that to provide for the normal growth of the railroads and to bring the equipment into proper shape at least $54,000,000 should be expended for shop machinery and tools within the next three years.

Selection of New Tools

Too large a percentage of the railway mechanical departments have in the past failed to make any thorough or scientific analysis as a basis upon which to order their shop tools and equipment. It is true that a number of them have had experts in charge of the machine tool and shop equipment, but even in equipping new shops no attempt, except in a very few isolated cases, has been made to make a thorough and detailed analysis of all of the requirements. The late L. R. Pomeroy showed how this should be done in a study which he made in connection with the equipment of the Scranton, Pa., shops of the Delaware, Lackawanna & Western. This included a listing of each operation for each piece of work in order to build four new Consolidation locomotives each month, and to make eight light repairs and thirty general repairs. The analysis included the number of pieces of each class of work which would have to be performed each month, the type and size of machine tool required for each operation, together with the average time per piece and the total days' work per month for each type of machine tool. This study, which included the machine shop and boiler shop, covered several hundred different operations, and by means of it it was possible to decide just what kind and exactly how many tools should be installed.

There are those who strenuously object to tackling the problem in this way because they insist that locomotive and car repair work differs materially from the manufacture of new work and that the repair of each locomotive presents a different combination of operations. This argument has been worked overtime and railway shop managements have got to get down to brass tacks and recognize that in dealing with the law of averages they can approximate very closely the demands that will be made on the shop each day or week. It is quite possible that the equipment at Scranton, when it was made to conform to Mr. Pomeroy's recommendations, may have needed some adjustment and rearrangement, and yet it is safe to say that it was far more satisfactory than if it had not been based on so careful and painstaking an analysis. It was possible to get away with rough and ready methods of selection in the past, but the changed conditions will require close and accurate attention to such details in the future.

Weak Spots Automatically Located

Assuming that a railway repair shop plant is already fully equipped and in operation, there is a splendid way in which its weak points in equipment and organization may be automatically located. For many years men of vision in the railroad mechanical department have insisted that shop production could be increased and certain marked economies effected by the inauguration of a shop schedule system which would in effect schedule the exact handling of each individual part in the operations of dismantling, repairing and reassembling the locomotives, so that the progress of the work as a whole would go forward uniformly and rapidly. The locomotive would be kept out of service a minimum time and any tendency to delay in the carrying on and completion of the various operations could be quickly located and remedied. In fact, it makes the shop superintendent or general foreman a real manager of the shop and automatically throws a large part of the routine work on the subordinates. One of its great advantages is that it automatically locates any weak spots in the organization and focuses attention upon them. It can be readily seen how this might result in the development of extremely forceful arguments as to why new and improved machinery is needed to replace the older tools, which, from the standpoint of production, are becoming obsolete.

It is a sad tribute to the lack of vision on the part of shop managements that it has taken so many years to awaken them to the possibilities of the shop scheduling system. Within the past year or two, however, it has been installed in a considerable number of railway shops and it is probably not too much to say that in the very near future it will be used generally in all of the larger shops at least. Such a system, supplemented by a capable machine tool and shop equipment expert, will readily locate those places where the railroads can invest their money to the best possible advantage in building up the weak spots and toning up the effectiveness of the locomotive and car repair facilities.

It is interesting to note that one important railroad system has recently started carefully to analyze the condition of each machine tool in its large shops, including among other things data as to the kind of work for which it is used, the percentage of time the machine is in use, the changes which will be necessary to increase the output 15 or 20 per cent. and recommendations as to whether the machines should be overhauled, improved, scrapped or retired to a smaller and less important shop.

On another road the mechanical department has been very successful in securing appropriations for new machine tools because the shop authorities in asking for new tools must support their requests with an analysis of how the work is being done by the old tools and just how it will be redistributed and what savings will be made when the proposed new tools are installed.

One of the great difficulties in the way of getting approval for the purchase of new tools or equipment is that under any conditions, and particularly under the present financial conditions, the executive officers must have placed before them strong, convincing arguments as to the returns which will be made from the new investment. Only in this way can a wise decision be made as to the order of precedence of the many items which come before them for consideration. The machine tool builder in trying to secure railway business should have a keen appreciation of this fact and should, wherever possible, assist the shop authorities, or those who will decide upon the purchase of the tool, to develop concrete facts as to the savings which will be effected by the installation of the new machine. In the past there has been too much rough estimating or guess work in deciding what new equipment was needed, and the average mechanical department officer has not realized the importance of backing up his requests with a clear and forceful analysis of the savings which would be effected by the purchase of the new tools and equipment.

Where New Machine Tools Are Needed

In general, what are the weak spots in railway machine tool equipment today and where is the greatest need for new tools?

With the high wages, scarcity of labor, great increase in the cost of rolling stock, and the extreme difficulty in getting new equipment the idle time of every car and locomotive must be cut to a minimum. The weakest spot in the railway mechanical department is its engine house or engine terminal facilities. Engine houses have been outgrown because of the rapid development in the number, size and capacity of locomotives.

One mechanical department officer has characterized a roundhouse as "a dark hole with a wall around it." Mechanics have had to work under the most discouraging and difficult conditions as to light, heat, ventilation and facilities. Meanwhile, the locomotives have been growing larger and larger, and the size of parts has developed so rapidly that the workmen have found it almost impossible and very expensive to handle them with the limited facilities at their disposal. Then, too, in the interests of greater efficiency and economy on the road, various devices have been added to the locomotives which have complicated the task of caring for them. The federal boiler inspection, which was later extended to cover the entire locomotive, has added greatly to the need for additional locomotive terminal facilities and conveniences. It is quite generally recognized that the effectiveness of the locomotives could be very greatly increased on most of the roads by a thorough overhauling and even rebuilding of most of the locomotive terminals.

Incidentally, very few of the engine houses have had an adequate equipment of machine tools; such tools as they have had in most cases were passed down to them when they were discarded by the repair shops. In many instances these have been absolutely unsatisfactory for the reason that most of the tools which can be used to advantage at an engine house must be simple, rugged and accurate and yet must readily handle a wide range of work. The older, lighter tools with a narrow range of adaptability have in many cases been unsuitable for the engine house. It is a good sound investment, both from the standpoint of performing the work and of getting better service from the locomotives, to have an adequate machine tool equipment at at least the important engine houses, thus relieving the repair shops of the lighter repairs which in most cases interfere greatly with the scheduling of the heavier repair work. It is significant that a large part of the tools now being ordered by the railroads are for use in engine house work.

In looking into the needs of the repair shop proper, we find that it is true that a few of the tools which may be classed as "ancient" were so well built that by an overhauling and the application of an individual motor they may give good service for some classes of work. Here again a careful study is necessary in which proper weight must be given to each of the several factors involved. Obviously, it will be foolish to make any great expenditure on the rebuilding of an old tool if when the work is all done the machine lacks important features of modern tools in the way of strength and convenience of operation. While it would be unfair to say that the older tools as a class should be entirely discarded, it is true that there are today many tools in railroad shops throughout this country which, in the interests of production and efficiency, should be discarded and sold for junk; it is not even advisable in many cases to think of trying to use them in less important shops or in engine houses.

In one large shop which is fairly well equipped with modern tools it was recently estimated on the basis of a detailed

study that about 5 per cent of the tools were obsolete. This shop, however, represents very much better than average conditions.

It may be argued that the roads cannot afford to buy new tools to replace the older ones. This is not true in many cases, for the roads are wasting more money by keeping the old tools in service than if they were to "take the bull by the horns" and get rid of them. There are any number of tools in the railroad shops of this country that are more than fifty years old, and many that were installed in the "sixties." How any mechanical department can justify the continued use of these tools is a question which it is difficult to answer.

It is important when a road is contemplating the purchase of locomotives that it consider at the same time the additional facilities which will be required to care for the new power. The shortsightedness of overlookng this was clearly shown three years ago when the roads under great stress awakened suddenly to the fact they had steadily been adding to the number and size of their locomotives for years without making a corresponding increase in the facilities for taking care of them. Not a few roads are today years behind in their machine tool and shop equipment. This must be made up.

Many special tools are needed in the shop today to provide for the larger car and locomotive parts which have been introduced in recent years. In discussing some of these special tools a mechanical department superintendent is responsible for the statement that: "We are performing many operations on old tools which should be done on modern tools at a saving in time amounting to 75 per cent at least."

A number of roads have found it profitable to establish central manufacturing plants to produce certain parts, wholly or partially finished, which could be shipped to the repair shops and engine houses. The possibility of savings are great. Not only is the manufacturing cost very considerably reduced because of the use of special machinery and quantity production, but the operations of the repair shop and engine house are not hampered by needless work. This development has created a demand for certain automatic, semi-automatic and production tools, and the indications are that the practice will be very considerably extended.

In looking over the special departments, a great need will be found in many boiler shops for adequate punching and shearing machines and bending rolls and flanging machines sufficiently powerful to handle quickly the heavy sheets which are used in modern locomotive boilers. The need of more powerful drill presses for some classes of boiler shop work is also apparent.

Many blacksmith shops are hampered by the lack of sufficient power-driven hammers as well as suitable presses for making steel car repairs, and forging machines of sufficient capacity to make parts which are now being formed on the anvil.

How Manufacturers Can Help

Machine tool builders, particularly those making types of tools specially adapted to railroad use, have given remarkable cooperation to railroad shop managements, not only in developing the special tools but in demonstrating them and in helping in many cases to plan for the arrangement of the necessary accessories in order to get the best use out of the tools. This has been appreciated.

Railroad officers have also been keenly appreciative of the concrete data which the machine tool builders have put forth in their publicity campaigns, showing exactly how different classes of work are done on their machines and accompanied, where possible, by time studies. This has helped the railroad men to bring the advantages of the machine tools in question before their managements in such a way as to have their requisitions approved.

There have been some criticisms of railroad shops because of their not having ordered more of the very high capacity machine tools. As one mechanical superintendent put it in discussing the problem: "The entire question of production is fully as much a question of shop management and mechanical engineering as it is of shop tools." Some mechanical department officers, for instance, have decided that it is better to smooth forge a side rod and machine only the ends than to provide a high powered machine to finish the entire rod. The machine tool builders can be helpful in assisting to work out problems of this sort.

There is another way in which the machine tool builders can co-operate with the railways. Director General of Railroads Hines, just before he retired from that position, made this statement before the National Press Club at Washington, D. C.:

"I regard the next two years as a peculiarly critical period. The opportunities for the development of discontent are very great. The increases in rates cannot inspire enthusiasm, and service is bound to be unsatisfactory, especially until a large amount of equipment can be constructed. Yet both these factors ought to be regarded as necessary incidents of the times in which we live." And again, "The prospects of success will be promising if there can be an attitude of patient support on the part of the public and a proper disposition on the part of the corporate agencies and labor agencies to cooperate with each other and with the commission."

The prosperity of the country and of your business depends on the success of the transportation machine. Will you do your part by cooperation, influence and patience to help put it on its feet?

LUBRICATION OF SOFT METAL BEARINGS*

BY W. K. FRANK

Friction is the name given to the force which opposes motion and is, therefore, ever present between the journal and the bearing. It is found in all manner of mechanical devices and, strangely enough, is one of our most valuable and at the same time most destructive forces. Without friction, brakes would lose their value and nuts would never be used on bolts. Trains would of necessity run on tracks provided with gear teeth, and we could not walk as we do now but would be compelled to find other means of locomotion. Friction, however, is not desirable in bearings. Although much experimental work has been done on this subject, the laws of friction are as yet but little understood.

The surfaces of all materials which appear smooth are in fact made up of microscopic hills and valleys. When two surfaces in contact are moved relatively to each other, the clashing of the points creats a force which opposes motion. Wear results from this action and the energy expended is converted into heat.

Fluids, as well as solids, show friction, and this has been described as the force encountered in rolling the particles of the fluid against one another. The laws of friction in fluids and solids are quite different, and these have been summarized as follows: For solids, dry or slightly lubricated, frictional resistance is proportional to the load; it is independent of the extent of the rubbing surfaces; except at very low speeds it decreases as the velocity increases.

In liquids the frictional resistance is independent of the load; is directly dependent on the extent of the rubbing surfaces; and increases as the velocity increases.

The function of the lubricant in bearings is to separate the surfaces by a film so that metallic contact does not occur. If such a separation does take place the friction resulting will

*Second article abstracted from a paper presented before the Engineers Society of Western Pennsylvania.

follow the laws for fluids. It has been well established by Tower that under conditions of perfect lubrication the journal is actually fluid borne, and in this case the laws of fluid friction may be applied. He showed that when a bearing is plentifully supplied with lubricant the friction depends very little on the load or the character of the surfaces, but is dependent on the extent of the surfaces, the velocity and the character of the lubricant.

Tower's experiments were made with the load and bearing above a journal, the lower part of which was immersed in a bath of oil. He found that the journal carried the oil between the surfaces and formed a film between them. One of the most interesting points of his experiments was noted quite accidentally. In the course of his work he had occasion to drill an oil hole at the top of the bearing and found that the oil flowed freely from it. He attached a pressure-gage at this point and determined that a pressure of over 200 lb. per square inch was developed, although his load was only 100 lb. per square inch of projected area. Later experiments showed that the pressure of the film at the top was greatly in excess of that at the sides and that it was greater on the discharge side than on the entering side. The thickness of the film has been determined as between 0.0013 and 0.0029 in.

However, in most applications such ideal conditions are not reached, and usually on starting the surfaces are in contact and subject to the laws of friction for solids. Lubrication is often interrupted or imperfect, by reason of improper distribution, and friction does not follow exactly the laws either of solids or of liquids, but is intermediate between them. This is the type of intermediate friction encountered in bearings with which the present paper deals, and it is necessarily an indefinite quantity depending on all of the named variables. It will be seen that the matter of the character and supply of lubricant, as well as the nature of the surfaces, will be important factors in determining the friction and wear of the surfaces.

Since lubrication is so vital in the matter of friction and wear, prime consideration should be given to it in bearing design. Every effort should be made to create a film, although it is not always practicable nor desirable to provide bath, flood or forced lubrication. Various methods for supplying the lubricant are in use. Drop feed lubrication, which is the simplest form, requires only a hole in the bearing through which the oil is introduced. Unfortunately, this hole is often placed at the point of greatest pressure, so that no opportunity is allowed for the establishment of a film. Introduction at the point of minimum pressure would probably reduce both wear and friction.

Saturated pad lubrication is employed in some cases, the most common example of which is the railroad car bearing. The bearing covers only the upper third of the journal and waste, saturated with oil, is pressed against it from below.

Ring or chain lubrication is used on many line-shaft bearings and on the bearings of electrical equipment. Chains or rings are provided of a diameter considerably larger than the journal and resting on it, and these run in grooves in the bearing and through a reservoir of oil. Good results have been obtained by this method, and it is claimed by some authorities that conditions closely approaching perfect lubrication are reached.

Flooded lubrication consists of pumping the oil or carrying it by gravity in large volume to the bearing and delivering it at practically no pressure. Perfect films are often obtained, and the added advantage of dissipating the heat of friction brings it into use with large high-duty bearings. Forced lubrication is used in a limited number of cases. Oil is pumped to the points of maximum pressure and a perfect film is maintained. The pressure of delivery at the bearing must, therefore, be above the pressure of the film, and ranges from 15 lb. per sq. in. to 600 lb. per sq. in.

Grease lubrication is applied principally to heavy, slow-moving machinery. Considerable friction is encountered from the lubricant itself, but under heavy pressures the "body" of the grease prevents abrasion by the tenacity with which it clings to the respective surfaces and separates them.

Oil grooves are resorted to in many bearings in an endeavor to secure a film. However, when the film is once formed the grooves are a distinct hindrance to its maintenance. Grooves should, in general, not lead into the region of maximum pressures, as in this case they may actually lead the oil away from instead of towards the place where it is most needed. Grooves should preferably be placed in the region of minimum pressures and should run parallel to the axis of the shaft. Care should be taken to round the edges of the grooves to minimize the danger of injuring the film.

In bearings subjected to heavy loads the oil or grease may be entirely squeezed from between the surfaces when motion ceases. Grooves to the pressure points will provide convenient reservoirs of grease for starting and thus prevent abrasion, and this is the only case where such grooves should be countenanced. Errors in locating grooves may be avoided, to a great extent, by keeping in mind the desirability of securing films.

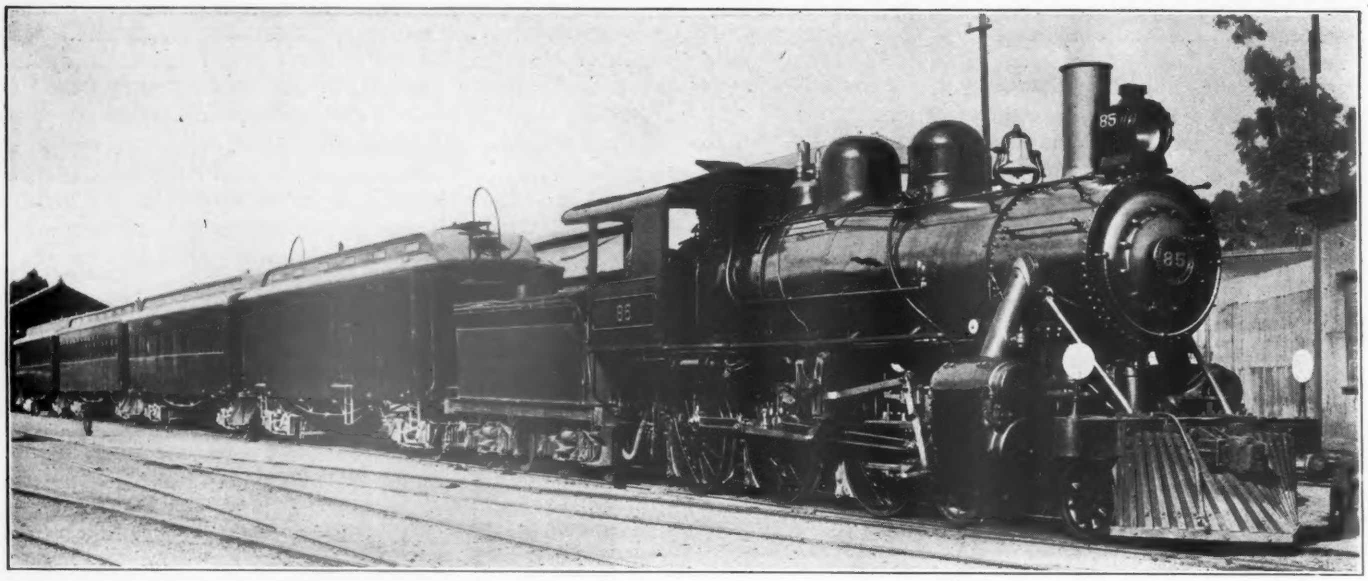
Another factor in securing proper lubrication is clearance between the bearing and the journal. Where the bearing covers only a portion of the journal, the latter can be made smaller in diameter, thus providing clearance at the minimum pressure sides. This is often further increased by planing away additional metal from these sides. The amount of clearance desirable will vary with the velocity of the journal and the nature of the lubricant, but in general it can be said that too much clearance will decrease the opportunity for the formation of a film. The error, however, is often made on the other side—that is, too little clearance is provided. It should be remembered that the bearing is often rigidly held, so that with a temperature rise expansion of both bearing and journal tend to decrease the space between them.

Clearance should be provided between bearing and container, whenever possible, to allow free expansion. Without this, expansion of the back of the bearing may cause pinching off of the lubricant at the sides and what are apparently perfectly fitted bearings, when cool, may be in fact very badly fitted when they become warm.

Dissipation of heat from the bearing is a matter which is often overlooked. The heat of friction is usually carried away by radiation, but in some cases cooling is accomplished by currents of air, oil or water. Water cooling is often employed, but in some cases this is not practicable and the bearing is called upon to run at high temperatures.

Bearing design is sometimes checked up by the product of pressure, in pounds per square inch of projected area and velocity in feet per minute. Various values have been assigned, ranging from 24,000 to 1,720,000. One manufacturer of heavy machinery limits this value to 60,000 for ordinary lubrication, while 1,100,000 seems to be good practice for locomotive main crank pins.

As will be seen from some of the precautions in design, the bearing that has the best lubrication will last longest, other things being equal. Grit and dirt will often start scoring, and it may be of interest, in passing, to note that this remedy is sometimes used in curing hot boxes. Bearings are occasionally so tightly fitted that little lubricant can enter between the surfaces. Minute oil grooves may then be secured by introducing a small quantity of powdered emery, which makes circumferential scratches on both the journal and bearing surface. Care should then be used in clearing the emery from the lubricant, as abrasion to a serious extent may be caused. Clean bearings, well lubricated and kept in alinement, should give little trouble when properly designed.



Standard Passenger Train on the Southern of Peru

RAILWAY EQUIPMENT IN SOUTH AMERICA*

Difficult Operating Conditions in Peru Have Led to the Development of Unusual Features

BY J. P. RISQUE

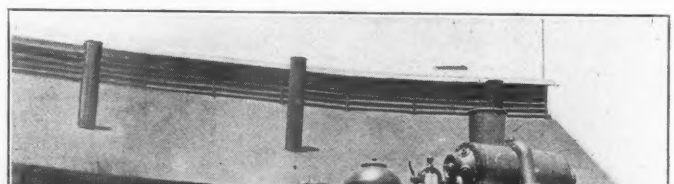
LIKE the old mariner who is said to have been able to detect the class and relative importance of a distant schooner by "the cut of her jib," a practical locomotive man inclines his opinion of a road in the direction of his impressions of its rolling stock. The track may be exceptional, the terminal facilities elaborate, but, as a staunch maintainer of his department's claim that "locomotives are the only things that really earn any money on a railroad" he will reduce his impressions to terms that are expressed in figures that relate to the prime mover. Naturally, those impressions will be tempered somewhat by the showing that is made in the road's cad department—otherwise the alleged truth of his slogan could not even have the importance that the other departments grudgingly allow it.

To this individual the size, type and class of power on a line, as well as the cars, their upkeep and apparent condition is the outward sign of the spirit of progress or its absence. He will just as naturally look for superheaters, feedwater heaters and other modern improvements that create economy and shorten time that doesn't produce, as he looks for sugar in his coffee. Their general omission is to him an index of the management's mental process toward the cost of the haul.

As the average American railroader's knowledge of the lines outside of his own country, and particularly of those in South America, is meagre, the reports that reach him from time to time from tired travelers in those parts to the effect that "the cinders from a wheezy old wood burner at the head end of the train, set fire to the clothes of the passengers in the coaches behind," have not perceptibly increased his interest in either the railroader or his equipment in those lands. This scant understanding of the extent and importance of some of the real transportation achievements on the continent to the south of us has, in a measure, deprived him of the benefits of some of the lessons they hold, chief among which is the lesson of thoroughness in every thing that is done.

British Equipment Predominates

A student of locomotive design who is more or less familiar with the principal characteristics of British practice would become impressed with the dominance of the latter



Cross-Compound Consolidation on the Southern of Peru Equipped With Dalzell Feedwater Heater

types, particularly in certain sections. That this condition is logical is attested by the fact that about 65 per cent of the roads are owned and controlled by British capital and operated by British nationals. And on other roads, operated by the governments of the respective countries or by other non-British owners, the type referred to is largely represented, due partly to the influence exerted by the performance

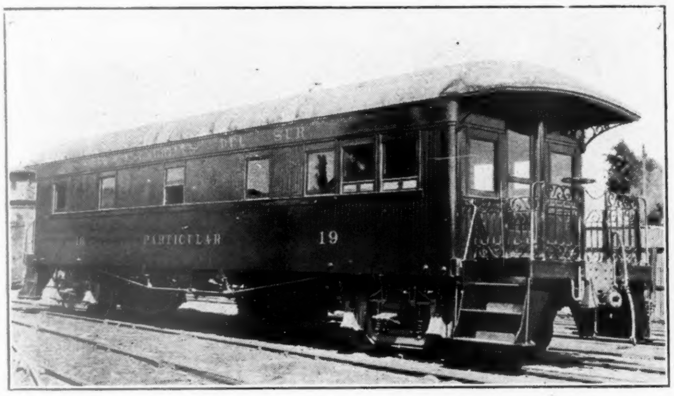
*This is the first of a series of articles by Mr. Risque, who has recently returned from a trip through South America as an editorial representative of the *Railway Mechanical Engineer*.

of those types and partly to the American builders' ancient indifference to the unexpected possibilities. Thus, in a trip of inspection over some of South America's principal lines, an observer would come to look upon the appearance of any great number of American built locomotives—and particularly of American design—as an exception, not a rule.

Descending the West coast the first important railways encountered are the various government owned short lines of Colombia, the nucleus of what will probably be, someday, a unified system. Further south is the narrow gage Guayaquil & Quito line operated by an American company between the two points named, in Ecuador. As neither of the aforementioned roads present significant differences in equipment or manner of operation, at least on a scale comparable with that which follows, a description of them is omitted.

The Railways of Peru

Among the very interesting contributions to the exception previously mentioned, is the equipment on the lines in Peru, controlled by the Peruvian Corporation, a British institution throughout, whose directorate resides in London. An American railroader would feel perfectly at home here, for

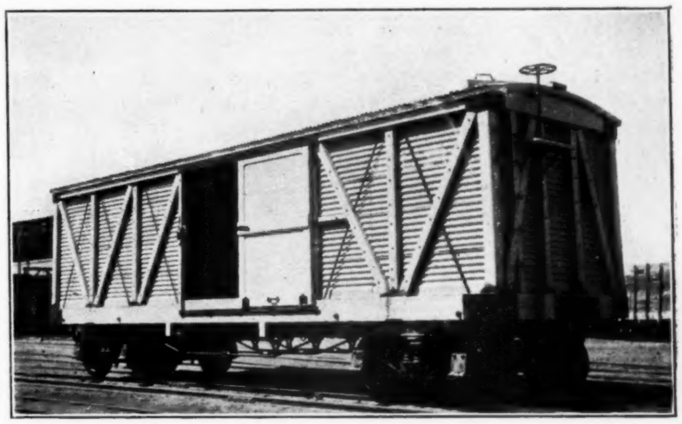


The General Manager's Private Car, Built Complete at the Arequipa Shops

with the exception of a few light side tank suburban locomotives of British design, the entire equipment is of American manufacture and style. For convenience in this description the corporation's holdings can be said to be located in three districts. The first comprises some lines operated north of Callao—unrelated short feeders from mines or sugar plantations, to the coast. The central of Peru, running northwest from Callao to a point on the roof of the world, called Oroyo, thence southwest a short distance to Huancayo, makes up the second section; and the Southern of Peru from Mollendo, inward to Lake Titicaca to Cuzco in one direction and La Paz in another, carrying its freight and passengers across the lake in its own steamers, composes the third section.

Aside from the shortness of the trains which are limited to four cars by the average lengths of 21 switch backs traversed in the run of 247 miles from sea level to an altitude of 15,665 ft.—all in seven hours—there is little to be mentioned as the equipment is American throughout. As words are inadequate to describe the scenery on this ride it will suffice to say that if this asset could be capitalized this road would emerge from the position of an obscure carrier of supplies from the Port of Callao to Lima and the mining camps in the skies above it, to the richest passenger carrier in the world, compared with which the present receipts from copper carried down the hill would be insignificant. This section is more a study for the locating engineer than a student of operation, many of the former of whom it is said can with difficulty conceive of the brain that planned it, much less comprehend the determination of the celebrated engineer who put it through. It is the engineering wonder of South America.

The third section referred to—the lines known as the Southern Railways of Peru—while somewhat less picturesque, offer many items of interest to a practical railroader. Here, too, will be found locomotives and cars and other interesting devices of American types and manufacture in the motive power department, where, during the war the chief mechanical engineer of the system, H. E. Dalzell,

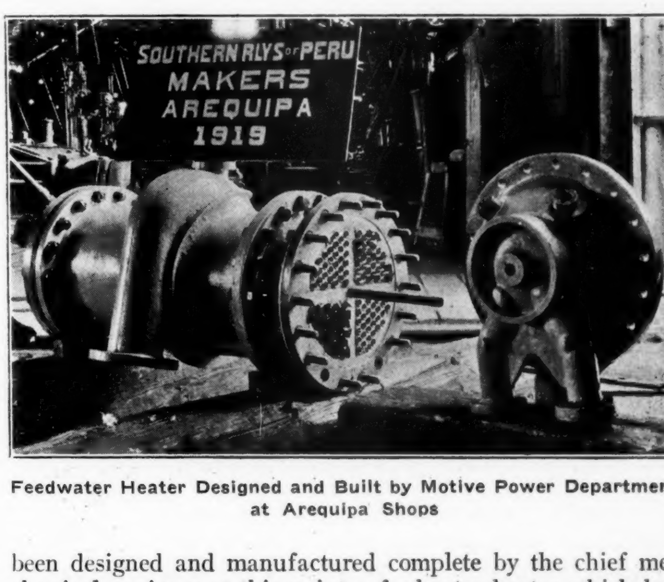


Standard 30-ton Box Car Built at Arequipa Shops

adequately proved the truth of the old assertion that "necessity is the mother of invention." For materials were scarce and some indispensables were unobtainable at any price. And as this period of distress seems to have so efficiently "put them on their own," they have been at it ever since. As a consequence much of the previous dependence on outside manufacturers has given place to home-made equipment, of which there is a variety.

Modern Equipment on the Southern of Peru

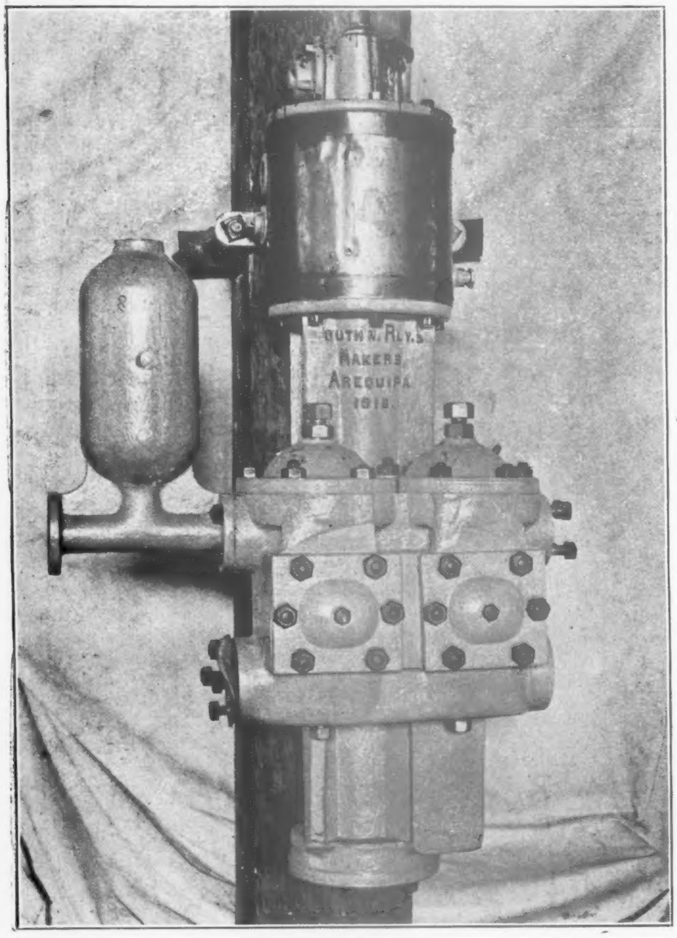
At the Arequipa shops, the principal repair headquarters for the line, the road turns out castings up to five tons, casts, assembles and applies complete superheater units among which are sets running successfully with the original slide valves aided by a special lubricating system. There has



Feedwater Heater Designed and Built by Motive Power Department at Arequipa Shops

been designed and manufactured complete by the chief mechanical engineer at this point a feedwater heater which has been applied to a 4-8-0 two-cylinder compound freight engine whose operating records showed an economy of seven per cent before the installation. The engineer on this particular locomotive in his competition for the monthly "fuel economy prize" has been handicapped 10 per cent over

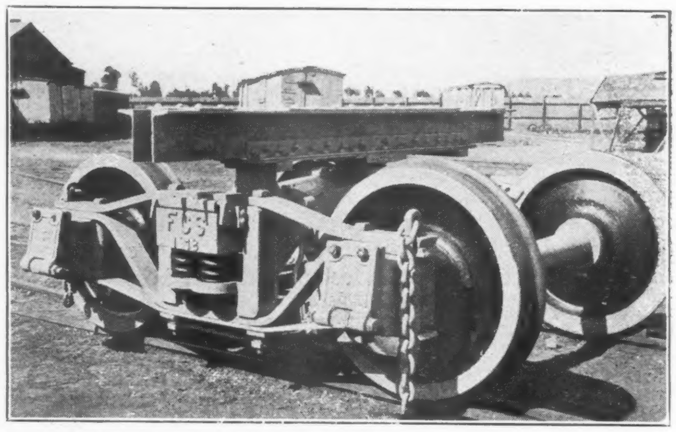
his fellows—but he always gets away with the money! As a consequence, the chief mechanical engineer is busy with materials for equipment of the remaining engines. The heater is mounted in front of the stack; the feed pump, the steam end of which is an old Westinghouse 9-in. cylinder, is mounted upon the right hand running board. The exhaust nozzle was reduced seven per cent for the purpose and a branch pipe carries a portion of the exhaust through a pipe in the top of the smoke box, over into the top of the drum of the heater. With water in the tender at 63 deg. F. and the pump running at 15 strokes per minute, the feed-water temperature is raised 140 deg. and passes under the check valve into the boiler at 203 deg. Results from the operation of this engine, No. 57, show that during five months' running repairs to the heater cost $5.10, while the engine hauled 178-ton trains up-grade against 160 tons hauled by those of the same type and size not so equipped. The kilos of coal per kilometer show 9.2 per cent economy in favor of the heater; kilos of coal per ton-kilometer re-



Feed Pump for Dalzell Feedwater Heater

veal an economy of 18.2 per cent. The actual saving in coal is 2.09 kilos per kilometer. As these engines are making 30,000 kilometers a years the total saving is about 62 tons a year, which at the prices paid for coal in these parts (56.77 soles per ton) is equivalent to approximately $1,775.

All front ends have been standardized, electric headlights are used on most of the passenger engines and orders for additional sets are being put through from time to time. All the corporation's cars are manufactured complete at the Arequipa shops and the only parts imported for the trucks are rolled steel wheels, chilled cast iron having been found impracticable owing to brake shoe friction and consequent excessive heat which cracked them. Seventy-one 30-ton box cars have been turned out at the Arequipa shops as well as twenty-three 50-ft. first-class passenger coaches, the latter electrically lighted from locomotive headlight dynamos. The plant is now preparing for the construction of two 60-ft., six-compartment sleeping cars and a 60-ft. diner, and a possible purchase of four locomotives was said to be under consideration. In and around the roundhouse and repair shops as well as coach building shops at Arequipa there is an air of effectiveness that is produced with an outlay that is meagre. The observer with his eye peeled for the reasons

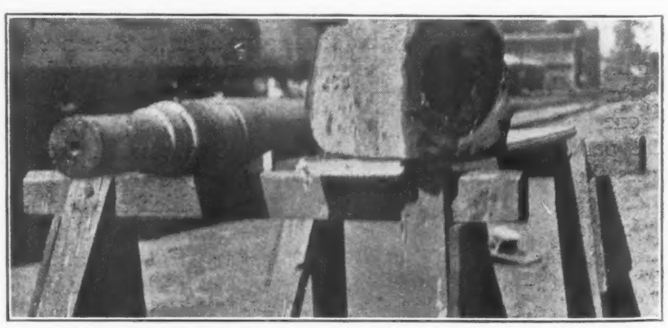


Truck Made Complete at Arequipa, Except Schoen Steel Wheels

will find that in the absence of steam for the blacksmith shop hammers (the works are run by electricity purchased from the local city power plant) compressed air from a motor-driven compressor is used. This air, piped around the place keeps the drop yard's 10-ton locomotive crane, as well as the air tools busy—of which there appear a variety. Three sets of Lincoln arc welders and an oxy-acetylene outfit are in use and there was in process of assembling, for use at outside points, a portable outfit comprised of a four-cylinder gasoline motor truck engine, belted to a dynamo and arc welding set.

Difficult Operating Conditions in the Andes

Grades and curves are the principal handicaps to the hauling problems on this mountain road. The coal consumption on the grade has been reduced by the use of superheaters, some of which are in use and others being put



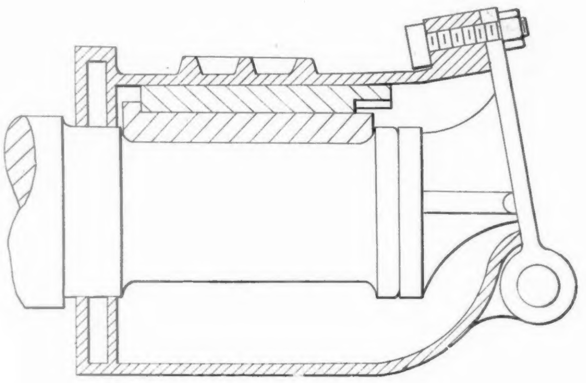
Wear on Axle End and Journal Box Caused by 90-Meter Curves

on as fast as engines are shopped, as well as by the use of the feedwater heaters described. Ten tons less dead weight in tenders is effected by cutting down the tender water space. Ninety-meter radius curves, with which the line is plentifully supplied, have played havoc with axles, cutting off the collars at the ends, making short work of brasses and boring out the inside faces of journal boxes where the hub of the wheel exerts its force in the end thrust.

A cure for this difficulty was found in the chief mechan-

ical engineer's design of a special journal box lid which has a lug cast on its inside face, on the surface of which is cast a bed of anti-friction metal about ¾ in. thick. The lid is held down on the box by two ⅞-in. bolts and raised letters on the lid admonish all concerned to "always keep the nuts screwed down." This device is being applied to all rolling stock gradually and is automatically prolonging the life of journals, boxes and brasses.

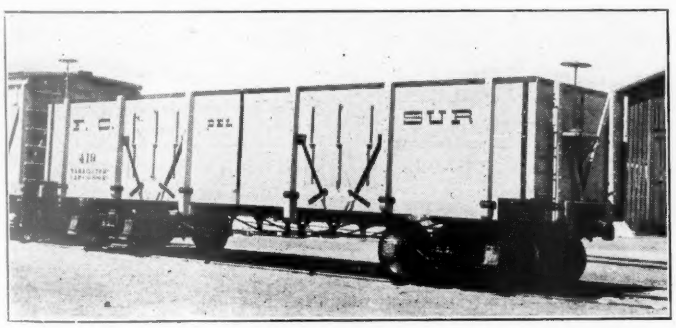
Old axles are reclaimed in the blacksmith shop by heating the ends, upsetting them and welding on a lug. A horizontal ram hung from the steel girders of the shop roof is operated by a cable attached to a clutch; the shifting of a lever swings the ram and the reinforced axle is then turned down in a lathe. One man and two helpers turn out reclaimed axles at the rate of five in seven hours.



Section of Dalzell Journal Box

Contrary to the general impression, the Southern, like most all of the South American lines, has had its struggles with the fuel problem. Coal has been costly and difficult to obtain. Previous to the outbreak of the war briquettes from Wales formed about 57 per cent of the supply at a cost of about $30 a ton at Mollendo. Since the war Fairmont, Pocahontas and Vancouver coal has been used. The mechanical department is now preparing to convert all power to oil and it is expected that by the end of 1920 Peruvian oil will be used universally on the system.

Water conditions are said to be fair all along the line with the exception of bad conditions on the Mollendo-Arequipa divisions, which are supplied by a pipe line from Arequipa all the way. Plans are under consideration by



Coal Car Built at Arequipa Shops. Note the Door Fasteners

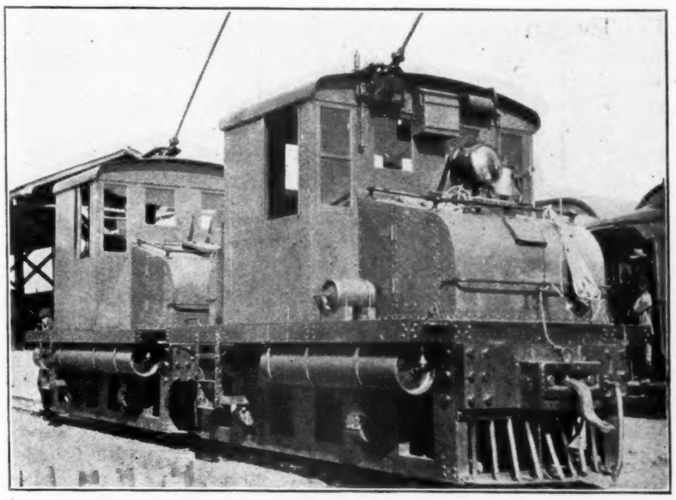
the management for improving this condition in some manner, either by the installation of individual water softening plants or a single unit at Arequipa.

All passenger trains are equipped with Westinghouse air brakes which combine straight air and automatic features. Freight trains are hand braked exclusively owing to the existence of a large number of old cars to which it has been deemed impractical to apply air brakes. For the same reason, link and pin couplers are found, old bodies being of insufficient strength to support the draft gears. As new equipment is built it is expected that the line will gradually outgrow the present forced limitations and will become standardized throughout.

Included in the interesting variety of equipment found on this railway are two Hudson supersix motor cars, equipped with flanged steel wheels with brakes on all wheels for the entertainment of tourists who are willing to pay the price for the novelty of a fast ride over the Andes. A testimonial of their worth and continued patronage is evidenced by the care with which they are maintained and their availability at a moment's notice. The operating results for these two cars show that they make 31 kilometers to a gallon of gasoline.

The Electrified Division

The electric division, running from a point called Alto, within nine kilometers of the terminal in La Paz, is constructed along a sheer cliff and the descent is 1,500 ft. with 6¼ per cent grade. Its operation required a choice between Shay type locomotives and electricity and the latter was chosen as the most acceptable solution of the problem. The power house is located slightly above the city of La Paz



Two 2-Ton Electric Locomotives on the La Paz-Alto Section

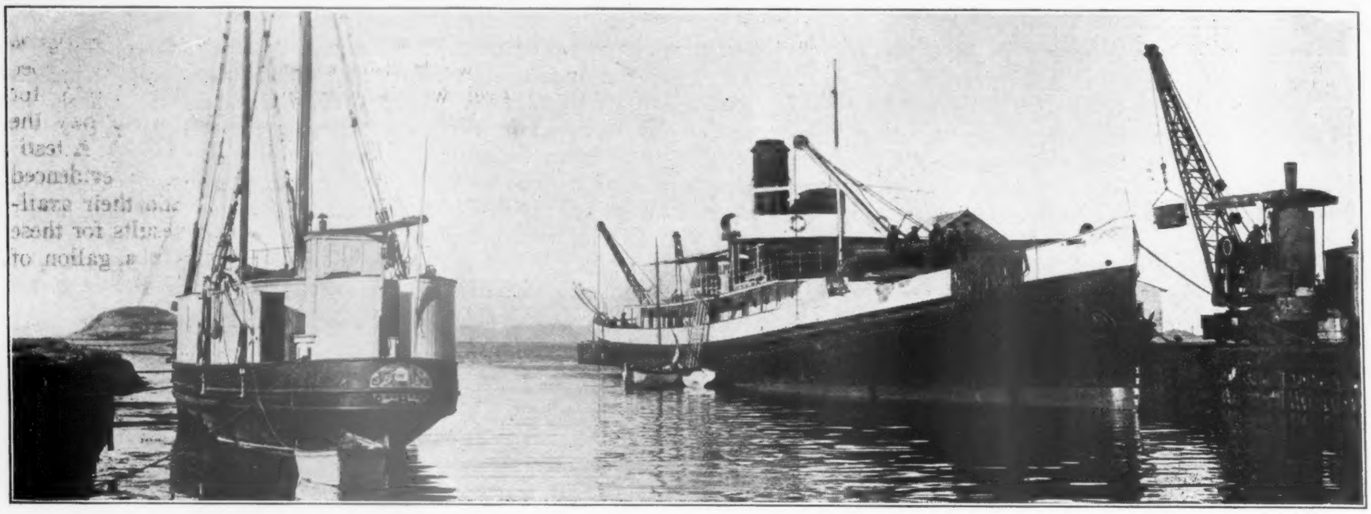
at an elevation of 13,000 feet and contains two Boleneder type Deisel engines which are capable of the development or 400 b.hp. at sea level. These engines are direct coupled to two 180 kilowatt, 550 volt General Electric generators running at 165 r.p.m. There are also two 400 hp. producer gas engines belted to two 150 kw. generators for emergency use. A 1,160 ampere hour capacity Tudor battery is run in parallel with the above plant and is charged and discharged through an automatic reversible booster. The line is of ordinary .0000 grooved copper wire, supplemented by ample feeders tapped into the trolley wire at intervals of every half kilometer. The motive power on this division includes two 20-ton, 550 volt D.C. electric locomotives of the type illustrated, four 4-wheel trolleys and four 4-motor combination baggage and express cars.

Equipment on the Lake Division

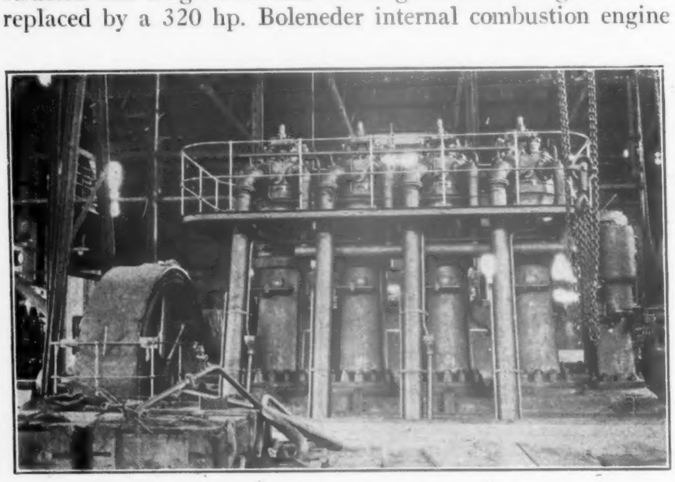
Puno on the west and Guaqui at the east end of Lake Titicaca, both being terminals on the division from Juliaca to La Paz, are adequately equipped for quick transfer of freight from cars to ships and vice-versa by means of batteries of four 5-ton steam cranes on runways. The loading record at Puno is 750 tons per vessel, in one day. Passengers descending the west coast, en route to La Paz, generally

arrive at the lake in the evening, and cross the lake during the night, but the picturesqueness of the scene is available to early risers the next morning.

The corporation operates four steel steamers on the lake. The largest ship in the fleet is the Inca, a 750-ton capacity cargo boat, built to British Admiralty specifications with twin screws, forced draught and superheater equipment and having accommodations for 70 first class passengers. This boat is generally used in the service between Puno and Guaqui, direct. The Coya is a 450-ton capacity boat, also with twin screws and a first class passenger accommodation of 74 and likewise makes direct runs. The Yavari, a 165-ton capacity ship is used as a coasting vessel, making about twelve local calls around the lake, discharging imported supplies from Mollendo and picking up wool, potatoes and other native products. Under the direction of the chief mechanical engineer of the line, this ship was recently entirely reconstructed and lengthened and the original steam engines were replaced by a 320 hp. Boleneder internal combustion engine for burning Peruvian oil. The fourth boat is the tug Yapura which carries 100 tons of cargo with two steel lighters of 120 and 200 tons capacity, respectively, which latter were built complete at the Arequipa plant.



Coaling Steamer Inca at the Puno Wharf



One of the 400 b. hp. Diesel Engines Working at 13,000 ft. Above Sea Level, Supplying Power to the 10 km. Electric Division

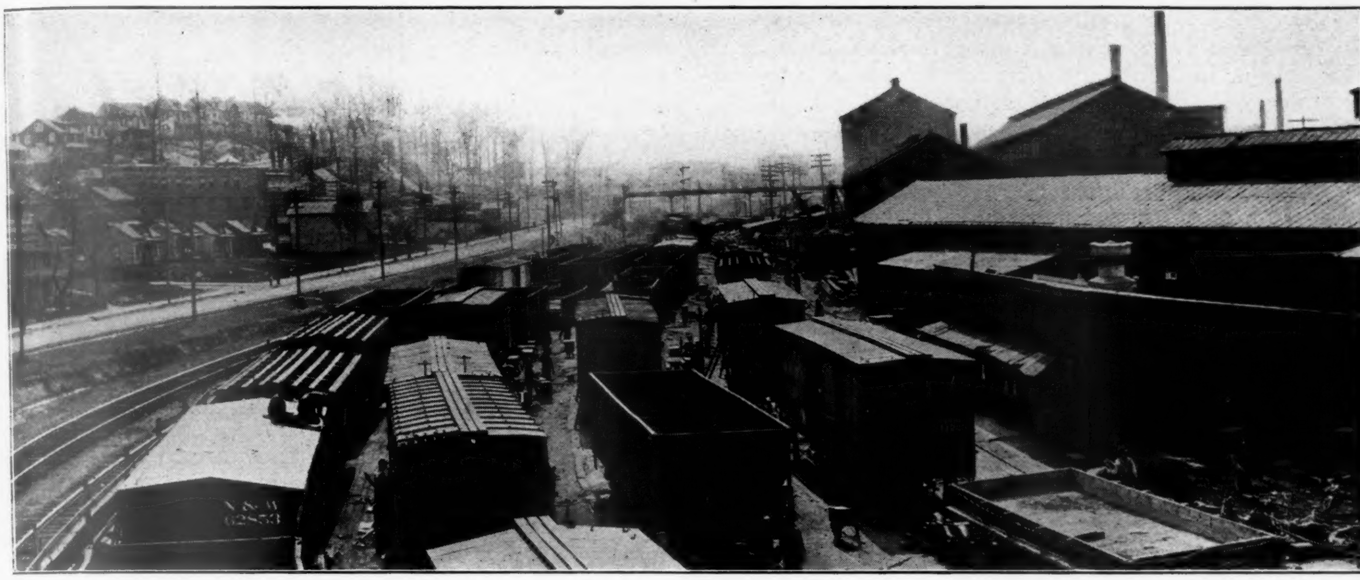
Practically all of the line's freight has its origin at the Pacific port of Mollendo, thus resolving the road's hauling problem into one of an up-hill struggle from sea level to an elevation of 14,000 feet, varied only occasionally by stretches of level pampa. Five and six car passenger trains are operated daily between Mollendo and Arequipa as well as a minimum freight service of two daily trains of 175 tons maximum up-grade, each way. Three passenger trains a week of six cars each and chair cars twice a week make the run from Arequipa to Puno. Four or five sections of freights of 175 tons each are sent up to the highest point called Pellones, beyond Arequipa, where the accumulated loads are hauled by one locomotive to Juliaca whence the loads are distributed for Puno and Cuzco.

BOILER CORROSION

In a paper on the Protection of Boilers from Corrosion, abstracted in The Engineer, E. Hoehn, engineer-in-chief to the Swiss Association of Steam Boiler Owners, of Zurich, describes experiments made by the association during the years 1915 to 1917 with a view to finding out the best means of preventing internal and external rusting. After dealing with relatively expensive methods, it passes on to the consideration of the use of protective coatings of various kinds. Some are proprietary compounds and some are not, but the two which appear to give the best results are cement and a mixture of 75 parts by weight of distilled gas tar and graphite. The cement has the advantage that it can be applied without any special precaution, while cases have occurred of men being overcome by the fumes of tar when treating the inside of boilers.

The discussion on the employment of cement is exceptionally interesting and is supported by a number of experiments made for the association both in a laboratory and in boilers in actual use. It appears that a thickness of about 0.02 in. is sufficient, and that if the wash is brushed on to a cold boiler and given 24 hours at least to set, it will adhere very strongly to the surface—even if it be slightly rusted to begin with—and that the higher the boiler temperature the harder the coating will become.

Of the mixture of tar and graphite Mr. Hoehn says that it is of the highest importance that only distilled tar should be used, as crude tar contains destructive acids. A wash of cement on the colder parts of boilers at least is no new thing, but it is doubtful whether it will stand the frequent changes of temperature and pressure and the consequent movements of the plates. The tar-graphite mixture is no doubt flexible and might not fail in the same way, but would it endure on the hotter surfaces? Such questions as these can only be adequately answered by prolonged tests under working conditions.



THE INSPECTION OF FREIGHT EQUIPMENT*

Maintenance of Trucks, Lubrication and Packing of Journal Boxes, Defects of Wheels and Axles

BY L. K. SILLCOX
Master Car Builder, Chicago, Milwaukee & St. Paul

ONE of the most important items to be considered to insure the cool running of journals is intelligent, systematic and periodical attention to the packing in boxes on equipment in service. Briefly, this should consist in lightly loosening up the packing with the packing iron to avoid the hardened and glazed condition which results when packing has remained too long in direct contact with the journal. This is not to be interpreted to mean that trains in service are to have the packing poked up more often than once in every five hundred to one thousand miles run, as otherwise it will result in it becoming all cut to pieces through continual jabbing and mechanical wear and tear. In explanation, trains on coast line runs may have the packing loosened up so as to come in contact with the journal or turned over with the standard packing iron at Aberdeen and Deer Lodge, as well as at originating terminals. It is the intention to change the packing in journal boxes under cars once a year, and as the date is clearly stenciled on the sides of the car showing when removal was last made, it will be necessary for car inspectors to follow this closely, and in case this is not being given the attention required they are to notify their immediate superior of the fact. Car inspectors and others are cautioned to examine the end of the journals at the centering hole to see whether they present a dry condition; if so, it is almost a certain indication that something is wrong and the brass should be removed and examined.

Wheels should be inspected to discover those having cracks, seams, flat spots, loose on axles, broken flange, chipped flange, worn flange, shelled out, tread worn, chill worn or worn beyond the condemning limit.

Lids on journal boxes should be lifted to make inspection of sponging, journal bearings and journal bearing wedges to see that they are in proper condition and journals not cut. Journal bearings and wedges should be in proper position in the box and the sponging in place well to the back of the box and up under the journal. Box lids should fit well in place and be properly secured to exclude dirt and dust. Under no circumstances are journal box lids to be left open for any considerable time or when trains pull out for the run. A supply of the various kinds of oil box covers must always be kept at hand and inspection stations must be fully equipped with some kind of cover or lid, at least, so that each box before it leaves for movement on the line will be supplied. In case of foreign cars, where no possible pattern, either wood or metal, is obtainable, a piece of wood or old galvanized roofing should be employed.

No part of the body or truck frame or attachments shall be less than 2½ in. above the top of the rail.

Preparation of Journal Box Packing

The standard instructions covering the preparation of journal box packing provide that the waste be carefully pulled apart and a known weight placed in the preparation vats, adding sufficient oil to completely submerge the waste (for 50 lb. of waste this will be 60 gal. of oil). The waste and oil should be allowed to stand for 48 hours; drawing off the excess oil (in above case this would be 35 gal.), leaving just a sufficient quantity to maintain the ratio of four pints of oil to each pound of dry waste. The work should be performed in a room at a temperature of about 70 deg. As the oil continues to drain, it should be drawn off from the bottom of the vat and poured back over the top of the waste, thus maintaining the proportion of four to one until all packing is used, and having the packing always ready for service. In tanks of two or more compartments, one can be used as storage for prepared packing, while the other is being used for the saturation of fresh packing.

The man in charge of the oil room should be thoroughly instructed to drain off the oil that settles in the bottom of storage tanks and to pour it back over the packing several times daily. By these instructions, it should be understood that when the oil is poured over the packing it must be equally distributed to cover the entire surface of the packing contained in the storage tank. The oil rooms should be kept

*Sixth of a series of articles on this subject by Mr. Sillcox.

clean and free from dust and other foreign matter at all times, and no dry waste or wiping towels allowed to be carelessly thrown in or mixed with the packing.

In addition to these tanks, it is necessary to have a metal container to hold rolls that have been made up of dry waste which have afterwards been submerged in oil. These are rolls to be used without carrying much oil, or in other words, moderately dry, in order to have them ready to apply to boxes at all times. The standard dimensions of these rolls is 2½ in. in diameter and about 11 in. in length. These rolls assist in better excluding the dirt in the back of boxes as well as holding the oil in the box.

A standard dope bucket should be used for handling prepared packing and nothing else. After a train of cars has been gone over by the yard or shop packer, all packing remaining in the bucket should be placed back in the storage tank until it is necessary to go over the next train of cars.

A standard packing iron should be adopted with a sharp end, and the forked end of this packing iron should be maintained in its original condition at all times, as continual use wears down this end. The packing iron should also have a lug about 12 in. from the handhold, which is used to open box lids. A suitable pulling hook is required for each packer on the shop tracks as well as in the train yards. A box packer's outfit should consist of the following standard equipment: Dope bucket, packing iron and pulling hook.

Method of Packing Journal Boxes

The packer should first place the prepared roll in the mouth of the box, using care to center the roll, then with the packing iron it should be shoved back evenly under the journal, so that it is in the proper position when it reaches the extreme back of the box. The packing should be picked up by hand and placed across the entire mouth of the box. This is absolutely necessary in order to keep the packing evenly distributed in the operation of placing it in the box. This method insures an even distribution while being placed in the box, due to feeding the packing in a continuous strand under the journal (not on the sides), until the box is completely packed to the center line of the journal, straight down from the inside face of the collar. Balance of box to be packed loosely with portions of prepared packing and to be separate from that back of the collar of journal. This is to prevent packing under the journal from working forward and away from rear end of box.

When wheels are applied the journals should be thoroughly cleaned, the bearing surface of the brasses coated with oil and a dust guard inserted. No waste, either dry or saturated, should be used in oiling the journal bearing, this to avoid any particle of waste or foreign substance remaining on the journal bearing when it is applied. A film of clean oil should be provided by pouring it from a can. Tight-fitting dust guards should be applied in all cases when wheels or journal boxes are applied. Where new journal boxes or integral truck sides are applied, the interior of the boxes should be free from scale and sand or any other foreign substance.

When the movement of cars is reversed while enroute it is found that the packing works to the rising side of the journal in a great many instances and will remain in that position in the reverse movement if not adjusted, causing journals to heat, as packing in this position will not feed oil to the journal. When box lids are found difficult to open, assistance should be obtained. In no case must a box be jacked up in the yards or shops without first removing all the packing. When a car is found with a hot box or a mark indicating a hot box, a careful inspection must be made to ascertain the cause of heating. If the journal is smooth, apply a new brass and repack with prepared packing. If the journal is rough, a new pair of wheels must be applied. Under no circumstances must a journal which has been heated be reapplied to a car unless it is in a perfectly smooth condition. A journal which has been heated sufficiently to discolor it must never be reapplied unless it is known to be perfectly safe to run.

Journal boxes of freight equipment cars must have the packing removed, the bearing examined and the boxes repacked as the cars receive classified repairs if the stenciling indicates that they have not been repacked within nine months. When newly packed or repacked, they must be stenciled as to the date and place where the work is done.

Care is to be taken to see that all new journal bearing wedges have a crown of almost 1/16 in., and this should be maintained in order to guarantee good results in service. Wedges having the crowned top surface worn flat and smooth for a length from front to back of more than 4 in. should be removed and replaced with new wedges where practicable.

Journal bearings for 5 in. by 9 in. and 5½ in. by 10 in. journals must not be employed in renewals unless at least 1 3/16 in. thick over all at the center. Journals not in service must be coated to prevent rusting. Care must be exercised in loading wheels for shipment and placing on storage tracks to prevent the flanges from coming in contact with the journals.

Truck conditions contribute very materially to the cause of journals heating on freight cars, as for example, the absence of nuts from column bolts and box bolts. Where the nut is missing from the column bolt, invariably the arch bar springs up, throwing the weight on the journal box and putting the box out of line. Where box bolt nuts are missing on trucks passing over low joints and crossovers, it has the tendency to allow the journal bearing to become unseated from the journal and bearing, also causing journal bearings to become broken. Cars with the arch bars worn at the column and box bolt holes, allow the box to cant inward causing the journal bearing to ride partially on the side of the journal. This defect of worn bolt holes is due primarily to nuts missing from bolts or nuts not drawn home, which allows the bolts to keep working upward and downward and also turning when the car is in motion.

Axles

In determining whether axles are worn beyond reasonable or safe limits to continue in service, it is well to bear in mind that the proper maximum limits generally accepted in removing them are (1) if the *fillets* at the back end of journals show less than ⅛ in. radius on axles of 40,000 lb. capacity (3¾ in. by 7 in. journal), less than 5/16 in. radius on axles of 50,000 lb. capacity (4 in. by 7 in. journal) and 60,000 lb. capacity (4¼ in. by 8 in. journal), and less than ⅜ in. radius in axles of greater capacity; (2) if the *journal length* is increased ½ in. over the standard original length when new; (3) if the *collar* is broken off or worn to ¼ in. in thickness or less.

When second-hand axles are applied to cars, the diameter or wheel seats and centers must not be less than the following:

A. R. A. Standard Design.

Nominal Capacity.	Limit Minimum Diameter for Wheel Seat.	Limit Minimum Diameter for Center of Axle.
140,000 lb. (6 in. by 11 in. journal)	7⅜ in.	6 5/16 in.
100,000 lb. (5½ in. by 10 in. journal)	6¾ in.	5¾ in.
80,000 lb. (5 in. by 9 in. journal)	6¼ in.	5¼ in.
60,000 lb. (4¼ in. by 8 in. journal)	5½ in.	4 11/16 in.
40,000 lb. (3¾ in. by 7 in. journal)	4⅞ in.	4 3/16 in.

Non-A. R. A. Standard Designs.

Nominal Capacity.	Limit Minimum Diameter for Wheel Seat.	Limit Minimum Diameter for Center of Axle.
70,000 lb. (4½ in. by 8 in. journal)	5⅝ in.	4⅞ in.
60,000 lb. (4¼ in. by 8 in. journal)	5 in.	4⅜ in.
50,000 lb. (4 in. by 7 in. journal)	4¾ in.	4⅛ in.
40,000 lb. (3¾ in. by 7 in. journal)	4⅝ in.	3⅞ in.

A. R. A. standard axles must be used in replacing A. R. A. axles subject to condemning limits for such axles.

A. R. A. standard axles may be used to replace non-A. R. A. standard axles of like capacity when overall lengths conform to A. R. A. standard lengths, at the expense of the car owner, except that in case of delivering line defects the charge against owner shall be confined to the difference in value between the non-A. R. A. standard axle removed and the A. R. A. standard axle applied. Non-A. R. A. standard axles may be used to replace non-A. R. A. standard axles in kind until October 1, 1920, subject to condemning limits for such axles.

A. R. A. standard 60,000 lb. capacity axles, with wheel seats less than the condemning limit for such axle, but above the condemning limit for non-A. R. A. standard axles, may be replaced in kind, or may be used until October 1, 1920, to replace a non-A. R. A. standard 60,000 lb. capacity axle when the latter is of A. R. A. standard length.

When axles are removed from service on account of wheels having owner's defects, if the diameter of the journal is not at least 1/8 in. greater than the limiting diameter shown, or if the journal is more than 3/8 in. longer than the standard length, or the collar is less than 5/16 in. thick, the axle shall be considered as scrap and so credited.

Rusted journals awaiting application to equipment may be cleaned off with sand paper; a file or emery paper should not be used. Journals should be calipered to see if they are worn hollow or tapered, also, if desired, a steel straight edge may be employed. If the difference between the diameter of the same journal measured at any two points is 1/32 in. or more the journal must be turned.

Axles must be closely inspected for seams, cracks or flaws. Seamy journals may be returned to service if the seams can be removed by turning within the required limits. Cracked or flawed axles should be tested by painting the doubtful parts with white lead paint, and then holding a flatter on the end of the journal and striking it with a sledge; oil working through the paint will indicate flaws. Axles exhibiting cracks or flaws, or showing signs of excessive overheating or below limits in any respect, must be scrapped. Brake rods and brake chains riding on axles must be avoided.

Defects of Wheels

Wheels are not generally safe for movement with the following defects: Slid flat cast iron, cast steel, wrought steel or steel tired wheels, if the flat spots are more than 2½ in. in length, or, if there are two or more adjoining spots each 2 in. or over in length.

Shelled out: wheels with defective treads on account of cracks or shelled-out spots 2½ in. or over, or so numerous as to endanger the safety of the wheel.

Brake burn: wheels having defective treads on account or cracks or shelling out due to heating.

When the worn spot is 2½in. or over in length. Care must be taken to distinguish this defect from flat spots caused by sliding wheels.

Seams—Seams in wheels ½ in. long or over at a distance of ½ in. or less from the throat of the flange, or seams three or more inches long, if such seams are within the limits of 3¼ in. from the throat of the flange on the tread of the wheel.

Broken or Chipped Rim or Tread—Broken or chipped rim or tread, if the tread measured from the flange at a point 5/8 in. above the rim or tread is less than 3¾ in. in width, or if the bearing face of the tread or rim which may engage the top and exposed face of the rail is more than 3¼ in. wide.

Cracked or Broken Flange or Chipped Flange—Cracked or broken flange, or chipped flange, if it exceeds 1½ in. in length and ½ in. in width.

Wheel Loose or Out of Gage—Wheels are out of gage if less than 5 ft. 4 in. over the outside edges of the rim or 4 ft. 5¼ in. between the inside edges of the rim.

Worn Flanges—Cast iron or cast steel wheels under cars of less than 80,000 lb. capacity, with flanges having flat vertical surfaces extending 1 in. or more from the tread, or flanges 15/16 in. thick or less, gaged at a point 3/8 in. above the tread. Wheels under cars of 80,000 lb. capacity or over, with flanges having flat vertical surfaces extending 7/8 in. or more from the tread, or flanges 1 in. thick or less, gaged at a point 3/8 in. above the tread. In the case of wrought steel or steel tired wheels, flanges having flat vertical surfaces extending 1 in. or more from the tread, or flanges 15/16 in. thick or less.

Bursted Wheels—If the wheel is cracked from the wheel fit, outward by pressure from the axle it should be immediately removed from service.

Type of Wheel to Be Used—Cars intended to be equipped with wrought-steel, cast steel or steel tired wheels, and so stenciled, if found with cast iron wheels, must be changed to the proper standard and at junction points particular care must be used by inspectors on equipment coming from connections and proper record and billing made.

Tread Worn Hollow—Tread worn hollow 3/8 in. or more for a distance of 3 in. is not safe to run and the wheel should be removed from service.

Speaking in a general way regarding the various defects, especially those encountered in connection with cast iron wheels, the following comments are made as information: So far as flat sliding is concerned, the particular point to be noted in cast iron wheels is that the length of the flat spot is generally definite in appearance: the borders of the flat spot are clearly defined and are not pounded out in service, but a characteristic noise is produced which is well recognized and which calls for removal of the wheel under certain conditions. The intensity of the blow on the rail for a flat spot up to 2½ in. long is not very great. The severity of the blow increases as the spot increases, until a maximum is reached at a certain speed, after which a decrease is shown. The critical speed is dependent upon the length of the flat spot. The longer the spot, the higher the speed at which the maximum blow is delivered. Conditions in a steel wheel are somewhat different because of the quality of the material which allows the boundary of the flat spot to be pounded out and lengthened until finally an eccentric wheel is produced instead of the short restricted spot as in the case of the chilled iron wheel. The long rounded spots do not produce a distinctive noise, and, therefore, are not noticed and often wheels remain in service until a very considerable eccentricity is developed, constituting a serious element of danger, especially in cold weather when the track is icebound. The only chance for a chilled iron wheel to develop eccentricity is when worn through the chill. The causes for flat spots in the chilled iron wheel are numerous, and if careful attention is given this matter a very material reduction in their number can be secured. It is generally known that from two to three times as many flat spots develop in the winter months as during the summer months in the colder climates.

The next item of great importance is the subject of broken flanges. The office of the flange is to direct the truck, and, therefore, one flange or the other is in almost constant contact with the rail and subject to rubbing or grinding under considerable pressure. This is especially true when traversing a curve where the flange pressure amounts to 10,000 to 20,000 lb. under ordinary operating conditions and impacts may, of course, momentarily double these amounts. This continuous grinding in the absence of lubrication, results in flange wear.

Seamy wheels, or a seam in the throat, is responsible for a considerable number of broken flanges. There are two classes of seams, one of which develops below the surface of the metal and is known as a blue fracture; the second occurring in wheels of low chill, which is of a progressive

type, starting in small cracks in the throat which eventually unite into a line representing a crack through the chill, which may progress through the grey iron and result in a broken flange. This type of seam can be eliminated by avoiding extremely low chill in the manufacture of wheels. The blue fracture cannot be detected until the surface metal (usually about 1/8 in. thick), is broken through, disclosing the seam below. This type is a foundry defect and can be avoided by pouring iron of the proper temperature in casting the wheel. The cause for these seams, as already stated, is that the iron when poured into the mold first fills the lower part of the hub and then travels through the bottom plate and brackets, filling up the flange. The section of the mold forming the flange is thin and the upper part is formed by the metal chiller. It will be readily seen that the metal in the flange would be cooled somewhat by passing over the cold sand of the mold and coming in contact with the chiller. This metal is also not stirred or mixed by the subsequent metal entering the mold, as it flows on top of that which forms the flange. It is evident that the metal in the flange has already set solid and has started to contract, while the metal above the throat is still in a pasty condition, with the exception of a thin layer of surface metal which was quickly cooled by contact with the chiller. The more rapid cooling and contraction of the metal in the flange, as compared with that of the tread, tends to cause a separation, or seam. This is only true, however, where the iron when poured was not of a sufficiently high temperature to set homogeneously throughout the tread and flange section.

Brake Burning—The question of brake burnt wheels has already been mentioned. In brake burnt wheels, the tread is broken up in fine hair lines running parallel to each other across the tread of the wheel, generally covering a considerable portion of the circumference.

In extreme cases the cracks may open considerably, even though no metal is broken away; this is brought about by the rapid heating and cooling of the tread over the area covered by the brake shoe.

In freight service brake burnt wheels are developed in great numbers in sections of the country where heavy grades are most frequent and where the tonnage per effective brake is greatest. On heavy grades the brakes are applied to control the speed and therefore the action may be prolonged indefinitely. Under such conditions there is very little danger of sliding the wheels, hence the entire circumference becomes intensely heated, and when the heat becomes excessive and is generated in a sufficiently short period of time, it will cause the metal to break up into fine heat cracks, which have already been described.

In most trains there are a number of cars in which the brakes are ineffective or cut-out. The effect of this is to increase the tonnage to be controlled by the remaining cars having effective brakes, and even under these unfavorable conditions there is not much danger of burning the treads of the wheels if the brake shoes are in proper position; but for various reasons the brake beam is not always central and one shoe may overlap the rim while the other crowds the flange.

The pressure on the shoe is not changed on account of its position, hence, when the bearing area is reduced the pressure and the resulting heat per square inch are increased in the same proportion as the bearing area is decreased. This accounts for the number of brake burnt rims and also for cracked flanges when the shoe bears heavily on the flange.

This condition is also quite likely to crack the plate of the wheel on account of the expansion at the rim while the tread of the wheel near the flange is cold, which produces a strong leverage, throwing the front plate into tension to such an extent as to sometimes cause the metal of the front plate to fracture for a distance long enough to reduce the pressure.

When a chilled iron wheel has become brake burnt and is kept in service, the subsequent pounding disintegrates the metal which drops out little by little and results in a condition called "comby from brake burn." This leaves the metal in a ragged condition, as the plane of cleavage is radial or perpendicular to the tread, and small particles of metal break off more or less irregularly.

In this connection, it is well to mention slid burnt wheels. When a wheel slides, an intense heat is generated almost instantaneously, and the metal is rapidly worn away, leaving a flat spot, often showing a fine network of hair cracks around the area of the flattened surface. This condition usually appears in spots about two inches long, either singly or at various parts of the same wheel. If the slid flat spot is not large enough to require removal and the wheel remains in service, the metal which has been disintegrated by the heat may break up and drop out, resulting in a condition known as "comby from sliding."

Shelled Out Wheels—The term "shelled out" refers to spots on the wheel where the metal has dropped out from the tread in such a way that a raised spot is left in the center, with a cavity more or less circular around it. In this case, in addition to the radial lines of cleavage, there appears a holding element of the particles making the wheel parallel to the surface of the tread, and, therefore, the bottom of the defect is more or less smooth, somewhat resembling an oyster shell.

The cause of shell outs does not seem to be as self-evident as that of comby wheels. The conditions which exist and give rise to shell outs will, therefore, be described in detail. The maximum air brake pressure is adjusted for the light weight of the car, hence wheels are not as likely to slide under loaded cars. Sliding often occurs just before a train comes to a standstill. This is occasioned by the greater efficiency of the brake shoe as the speed of the train decreases. The greatest frictional resistance between the wheel and the brake shoe occurs just as the wheel is about to stop revolving and often at this point exceeds the frictional resistance between the wheel and rail, in which case the wheel begins to slide. After the wheel once begins to slide, the friction between the wheel and the rail is very much lessened and sliding will continue until the brake pressure is reduced.

When the sliding is over a distance of only a few feet before the car comes to rest, the term "skidding" is applied and a small skidded spot the size of the area of the wheel in contact with the rail is produced. A flat spot no larger than the contact area shown is not sufficient to cause the removal of the wheel, but the subsequent blows received in regular service very often result in the metal breaking or shelling out around the surface of this contact area, forming a shelled out spot.

During the time the wheel is sliding, all the mechanical energy represented in the resistance to motion is transferred into heat through the agency of friction; and as mechanical energy and heat are mutually convertible, the exact amount of heat generated can be easily calculated and it is a matter of common observation that often the melting point is reached.

Cracked Plates—The question of cracked plates is another matter deserving serious attention. The primary cause of cracked plate wheels is an expansion stress, due to sudden heating of the tread while the plates are cold. When the brakes are applied continuously, a rapid expansion takes place in the metal of the tread which produces a strong tensile stress on the plates. Usually the heating is more severe toward the rim, and, therefore, there is a greater stress on the front plate than on the back plate.

In addition to the temperature stresses, the flange pressure reacts on the plates, producing a tensile or pulling stress on the front plate, and a compression on the back plate, hence the combination of stresses on the back plate

tends to equalize each other. Too much care cannot be exercised by inspectors to locate cracked plate wheels, as they are a source of tremendous danger in service.

Worn Through Chill—The defect known as worn through chill cannot often be discerned by the appearance of the tread and manner in which it is worn. If worn irregularly, that is, deeper at some places than at others, or if worn flat, it is evident that it has worn through the chill. Wheels seldom wear through the chill all around the tread at the same time; therefore, when a wheel is worn evenly, no matter how deeply, or shows the shape of the rail all the way around (commonly termed "railworm"), and has no appearance of being worn flat at any place, there is a good reason to question whether it has worn through the chill. This can be determined by polishing the tread with emery cloth, breaking off the flange with a sledge, denting the tread with a chisel, or breaking the wheel. When the first method is used, if a few small black dots of graphite can be seen, the wheel is just starting to wear through the chill. If the graphite shows plainly, it is well worn through the chill.

A method in vogue with some railroads is to dent the tread with a chisel, and if the chisel makes a deep mark without blunting its edge, the wheel undoubtedly is worn through the chill.

Tread Worn Hollow—The amount a wheel shall be worn in the tread to warrant its removal from service is left largely to the judgment of the car inspector. The idea is that wheels should be removed when worn sufficiently to permit the rim to project far enough below the top of the rail to render it liable to breakage when passing over frogs, or when the flange becomes so high that its end is likely to strike the bottom of flange ways. When wheels are worn excessively hollow, damage is done to the track at frogs and crossings on account of the overhanging rims and the high flange, which causes excessive pounding, resulting in rapid deterioration of the track at these points and often breaking off track bolts. It is the practice in track work to allow a minimum of 5/8 in. for flange clearance at the bottom of flangeways in frogs, crossings, guard rails, etc. This allows for the tread to wear down 5/8 in. before the flange would strike the frog and crossing fillings on new rails. It is customary in the heavier rail sections to allow more than 5/8 in. below the end of the flange. This is a matter which needs attention locally to meet the daily requirements of service.

The minimum amount a wheel shall be worn hollow is not specified for freight service, but is generally conceded to be 3/16 in. Some railroads recommend that wheels be allowed to wear down 3/8 in. before condemning them, unless worn through the chill.

Worn hollow is the legitimate condition of worn out wheels. In the lighter capacity cars, the percentage of wheels removed for this cause is large, while in the heavier capacity cars flange wear is greater and also all of the heat defects are in greater evidence, hence the percentage of worn tread wheels is reduced. Wheels which crowd the rail on one side or the other should be very carefully observed. Complete sets of suitable wheel gages with complete instructions are sent to any station on the system making request for them.

Guarantee on Cast Iron Wheels—It is occasionally necessary to purchase wheels from outside concerns. This material is purchased under the guarantee shown in the table below, and where renewals are made within the period stated due to manufacturer's responsibility, claim must be made for replacement, all cases being fully written up to the master car builder and the wheels held for disposition. Wheels manufactured in the railroad company's foundry must be checked up just as severely and any failure in service reported in the same way and the wheels held for examination.

Wheels which fail to render this service on account of any defects in material or workmanship will be replaced free of cost to the railroad upon delivery of the defective wheels at the works. The wheel makers do not replace wheels which fail to render the guaranteed service on account of flange wear nor wheels removed *in pairs* on account of shelling out.

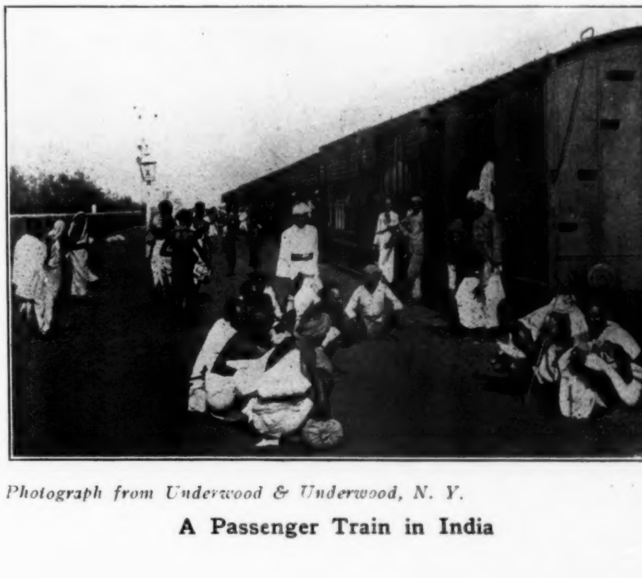
Cast Iron Wheels, Guarantee

Size of wheel	Weight	Axle	Capacity	Number of years' guarantee from time date marked on wheel
33 in. diameter....	625 lb.	4¼ in. by 8 in.	60,000 lb.	6 years
33 in. diameter....	700 lb.	5 in. by 9 in.	80,000 lb.	5 years
33 in. diameter....	725 lb.	5½ in. by 10 in.	100,000 lb.	4 years

AN INTERESTING CHAPTER FROM AMERICAN RAILROAD HISTORY

"The Portable Boats of Early Railroad Practice" is the title of an article written by J. Snowden Bell and recently published by the Baldwin Locomotive Works in the form of a booklet included in the Records of Recent Construction (No. 97). The book describes what in the 30's was referred to as "the great transportation system" extending from Philadelphia to Harrisburg. This was principally a canal route connected by stretches of railway for which Mathias Baldwin constructed the early locomotives, and which later was absorbed by what is now the Pennsylvania railroad. The first pages relate the entertaining narrative of a pioneer who crossed the Alleghenys with the first portable boat and made his way down to the headwaters of the Mississippi. This boat was not designed as a portable affair, but was intended to be sold on his trip west when he reached the point at the foot of the mountains where rail transportation replaced the canal barge. It was found practicable, however, to cut the boat in sections, load it onto flat cars, and thus transport it over the mountains. This led to the construction of many sectional boats, the details of which, together with the cars specially constructed for this service, are well described and illustrated with some of the very early patent drawings covering these conveyances.

The Baldwin Locomotive Works deserve credit for giving wider circulation to a phase of American Railroading that is fast slipping into obscurity, and are fortunate in securing the authorship of Mr. J. Snowden Bell. It is hoped the publication of this fascinating page from early American history will lead to greater publicity concerning American railroads in the making.



Photograph from Underwood & Underwood, N. Y.

A Passenger Train in India

COST ACCOUNTING—THE KEY TO COST CONTROL

A Discussion of the Advantages of Cost Keeping with a Description of a Typical System

BY GEORGE W. ARMSTRONG

CONTROL of industrial operation requires a panorama, a perspective bird's-eye view of the multitudinous activities of that industry. Effective control requires more, it requires an intricate, digested knowledge of the details of those activities; requires a knowledge as to the equivalency of return for expenditures to successfully avoid the wastes which cannot otherwise be detected.

Railroad accounting is clearly defined by Interstate Commerce Commission regulations. This uniform classification of accounting, aside from any inherent merits or defects, serves the purpose for which it was designed. It furnishes, indeed, statistical data of the most valuable kind for the railroad executive in charge of the property, for the investor and for the regulating commissions. But the reports of railroad operation as a whole fail to throw light on the details of its productive activities.

Cost accounting is concerned with the details of these primary accounts in railroad operation. One of the prime functions of cost accounting is to enable the executive in immediate charge to know details promptly. Records of cost by themselves do not effect economy, it is only by their proper presentation in convenient and convincing form to the executives responsible, that these executives can correct inefficiencies, pointed out by these records, through improvement in organization, administration and in individual processes and methods. The degree of refinement in a cost accounting system should not exceed that required to secure this result, i. e., effective control. The essentials of any cost keeping system are:

That it accurately account for materials and supplies purchased and given out.

That it charge labor to the work on which it is employed.

That it furnish an accurate check and distribution of overhead expenses or burden.

That it record facts and conditions and provide for current interpretation of their significance.

This discussion will be confined to the Maintenance of Equipment but it is not inapplicable to the other branches of railroad operation. The Interstate Commerce Commission Statistics of Class I railroads for the year ending June 30, 1916 indicate the expenses for Maintenance of Equipment to bear the following ratios to total operating expenses:

Maintenance of Equipment—Steam locomotive repairs, 8.017 per cent; freight train car repairs, 8.18 per cent; passenger train repairs, 1.563 per cent; total, 17.760 per cent.

Transportation—Engine house expense—yard locomotives, .506 per cent; train locomotives, 1.642 per cent; total, 2.148 per cent. Aggregate total, 19.908 per cent.

The summary of statistics for Class I railroads as issued by the Interstate Commerce Commission to December 31, 1918, shows that the percentage of operating expense applied to maintenance of equipment in 1918 was 27.73 per cent instead of 17.76 per cent as given above for the year ending June 30, 1916. The details of division to steam locomotives, freight train and passenger train car repairs, and for engine house expenses were not available, but the increasing magnitude of this branch of operating expenses can be visualized by the comparison.

The Function of Cost Accounting

Cost accounting with respect to these operating expenses should embrace sufficient detail to reflect accurately the distribution of expenditures, to insure quick analysis of details and furnish cost data for expert analysis as close as possible in point of time to the occurrence of the charge. Close relation between responsibility and cost is the active agency required for improving operation. Refinement of detail beyond what is necessary to provide data for effective control is not justified, but the absolutely necessary cost of control, whatever it may be, is worth the cost.

Results will not be secured from cost knowledge if confined solely to afterthought analysis. The cost agency should also embrace means to predict in advance results with respect to new needs based on past performances. Otherwise it will be impossible to avoid excessive expenditures in many instances for articles which can be more cheaply purchased. On a large trunk railroad recently, the need developed for a rather large number of pieces of a certain forging on Mikado type locomotives. An initial lot was made under the steam hammer, machined and applied. Analysis then developed that these parts cost from two to three times more for labor and material alone than better drop forged parts that could be purchased in the open market. Advance cost analysis would have determined this without the loss incurred in this instance. Similar examples can be duplicated daily in our railroad shop operation.

Cost accounting is needed in railroad operation today as never before. The prices of materials have increased, labor has doubled in cost, productive efficiency has lessened. The times demand that the trained finger of management maintain unbroken contact with the pulse of production.

Disproportionate relations existing between the labor and material components of shop operations compared with those existing in pre-war times may necessitate modifications in practices. Where under former conditions things could be produced economically, purchase may now be cheaper. Machine tools and shop facilities at one time adequate may have become utterly inadequate viewed in the light of present wages and restricted production. How can these questions be settled without the aid of an efficient cost accounting system?

Proving Economies

The superintendent of motive power of a large trunk line recently stated: "I am almost convinced that we should make everything possible for locomotive repairs at a central point, where we can install the best facilities and get the benefit of quantity production. Then we should make our repair shops simply dismantling and assembling shops, doing only what other work is necessary to repair worn parts." How are the roads to determine whether that should be their goal in the future, and whether it is productive of economies predicted, if not given the aid of an efficient cost accounting system?

It has been said figures do not lie. The corollary to this is that a true interpretation depends on accurate analysis. And if figures sometimes lie, they also talk. Many conditions are tolerated, inadequate and woefully inefficient facilities are maintained, practices are perpetuated because figures are not given their opportunity to talk. Cost knowledge is lacking to discern which is unprofitable, cost knowledge is not at hand to drive home to the railroad executive the true economy of improving conditions, facilities and practices.

E. J. Pearson, former Federal Manager, now President of the N. Y. N. H. & H. in the discussion of Mr. McManamy's

paper before the New England Railroad Club said: "There is no executive and no board of directors that knows about your old lathe . . . why at the Southville roundhouse . . . engines are being delayed and traffic is not handled, although they may know that traffic is not moving as it should. They don't know the particulars of your needs unless those who are on the firing line put the case in shape and submit it, and do it so concisely, clearly and effectively that it will compel consideration on its own merits.

"Every one financially interested in a railroad is interested in the service, but particularly in the dollars and cents that are left at the end of the month. . . .

"If improvements are advantageous and hence money makers, the cheapest thing that any railroad can do is to make them. If there is some improvement that will pay twenty-five per cent on its cost and money is worth six per cent, there is nineteen per cent of velvet right there. . . .

"I agree that improvements recommended by Mr. McManamy aggregate big if you get the right ones. There are many of these projects that are presented simply because they are a good thing and when analyzed are explained as being desirable, that somebody else has them, that they are modern, or for reasons equally intangible. Bankers do not finance on statements of that character, but they do understand clear, concise statements that prove you can make nineteen per cent velvet as a result of the undertaking. . . .

"The point I desire to bring home to all is the necessity of working out your case, proving it and of then presenting it understandingly. Reduce your proposition to the absolute necessity, the benefits, the savings and the advantages and put it in shape so that when it comes up to those who do not know the details of the mechanical business, but do understand net returns, and on whom in the final analysis we must depend to finance these needs, the situation is made clear to them."

A Plan of Cost Accounting Discussed

Bearing in mind the essentials of cost accounting and its crying need, it would be well to consider its method of accomplishment. The first question to be answered in determining upon a system is: What is cost accounting expected to accomplish on a railroad? Is it to secure a record of the exact cost of each shop operation, or to furnish an aid to production and a means of determining whether an equivalent return is secured for value expended? Obtaining a complete distribution of the time consumed by each workman on each operation will not solve the cost problem, but will result, the more complete and elaborate such distribution is, in getting further from the desired result. The only result will be a tremendous volume of detailed information practically impossible of digestion. This will neither serve as an aid to production nor a measure of equivalency.

Shop Distribution

The output unit for locomotive shop operation is the locomotive, but this for purposes of cost accounting is as much too unwieldy as the detailed distribution is too elaborate. For constructive analysis in directing operation, controlling and determining policies based on cost accounting facts, and for finding whether a proper equivalent is secured for money expended, labor and material distribution should be made to master classifications of work by key reference and locomotive number. A standard key, either using a mnemonic or figure reference used as a prefix to the locomotive number should be established. Provision should be made for checking labor distribution directly in the department and without imposing an additional burden on the foreman. Material orders should be issued by one or more men delegated primarily for that duty, thus insuring proper distribution as well as a check on the disbursement of material. The suggested divisions of charges would be

Engine Trucks.	Driving Boxes.
Cylinders and Guides.	Spring Rigging.
Pistons, Piston Rods and Crossheads.	Wheels.
Valves.	Trailer Trucks.
Valve Gear.	Rods.
Power Reverse Gear.	Steam Pipes.
Front End.	Air Brake Work.
Flues.	Cabs.
Frames.	Cab Fittings.
Lubricators.	Stoker.
Injectors.	Superheater.
Electric Headlight.	Brick Arch.
Boiler.	Tender Frame.
Fire Box.	Tank.
Grates.	Tender Trucks.
Ash pans.	Draft Gear.

Given such a distribution of charges, a standard can be established based on experience which will serve as a measure of equivalency without the recording of details. However, sufficient detail should be recorded as to operations, so that the data can be employed at a future date for compiling unusual cost data or checking marked variations. As an aid to production, working on a day work basis, details of operations together with time consumed should be recorded only if currently associated with a standard time basis of comparison. The record of efficiency thus furnished will only be of value if followed up close to the event.

In many shops, labor conditions, aside from the additional factor of the expense and waste of time, will demand that records be secured with the least disturbance of shop management. The simple, sensible way to handle labor costs is that advocated by G. Charter Harrison,* i. e., "to set time standards for each operation and instead of recording the time spent by an operator on every job he performs during the day to compare his total time for the day with his production figured in terms of standard time. Under such a method all that is required in the form of time clocks is a regular in-an-out clock recording the actual time spent on the premises, and a record of the work which the man produces."

The accounting for the material used should follow closely the same lines as the distribution of labor charges. It should do more, however; it should involve the installation of a perpetual inventory system for handling storehouse material, which should be accurately checked at intervals with actual storehouse stock. Adjustments in storehouse balances should be made systematically throughout the year, instead of at the time of a fiscal annual inventory. Care should be taken to keep adjustments to a minimum, accounting as accurately as possible for disbursements currently.

Distributing Overhead

A separate account should be opened in the shop expense ledger for the indirect expense in each department, leaving only that portion of the indirect expense impossible to definitely locate to be generally applied upon the whole labor payroll of the shop. This results in an accurate check and distribution of the overhead, and is an effective means of minimizing indirect expenses. The indirect expense thus allocated to a department should be applied to the direct labor of that department.

Effective control is insured by definitely allocating expense by fixing responsibility along department lines. This fixes individual responsibility and gives the department executive the means of telling whether his costs are high or low, as his labor cost is forecast by the group distributions.

All distribution of labor should be made daily, by departments and distribution balanced with the labor payroll of the department. Material distribution can be cared for at less infrequent intervals.

Engine House Distribution

The problem of accounting for engine house expenses is a different problem from that of shop operation. The ideal possibly would be allocating of expense pertaining to each

*Industrial Management, Jan., 1920, p. 13.

individual engine for purposes of comparison as between classes of equipment and determining the particular engine of a class which is disproportionately expensive because of some fault in repair or construction. However, dependable figures as to individual engines cannot be secured except at a cost not warranted by the value of the results. It would require a force at each terminal to check each workman on and off each job, and it would not serve any more useful purpose than could be accomplished in a simpler way.

Engine house expense should be distributed as to labor and material to major divisions of maintenance work, in addition to the terminal operations, for example:

Front Ends.	Spring Rigging.
Cylinders.	Wheels.
Valves.	Cab Work.
Valve Gears.	Stoker.
Air Brake Work.	Superheaters.
Rods.	Tanks.
Boiler.	Brick Arches.

Subdivisions as refined as those employed in shop operation are not required but sufficient subdivisions should be made to give useful checking groups as between terminals as well as judging the efficiency of the particular terminal at any time. These subdivisions would follow closely the

Lorain N 801
30M (A 10m) 10-1-18—22x34-26c FORM 2426
UNITED STATES RAILROAD ADMINISTRATION
W. G. McADOO. DIRECTOR GENERAL OF RAILROADS
BALTIMORE AND OHIO RAILROAD
MOTIVE POWER DEPARTMENT.

Mt Clare Station, 8-16 1919
Mr. F. Paulis

Please furnish 200 Major Knuckle Pins
1 1/8 a - 12 1/2 B - 13 1/4 C
17220 E-25 G
Finegan
Isaac

Charge Cost to S. O. 80356

When ready, notify me by attached Coupon.

Form of Material Order

assignment of workmen, and so would involve a minimum possibility for error, even if the workman was depended upon for time-card distribution.

An approximately accurate analysis of costs for different classes of power could be secured from these subdivided costs by equating them on the tractive power mile basis or ton mile basis for the division.

Having considered the abstract needs for cost accounting, and a theory as to application, it might in conclusion be interesting to analyze a system embodying many of the essential features which is in actual use on the Baltimore and Ohio Railroad at their Mont Clare, Baltimore, Md., shops.

Cost Accounting Concretely Applied

This description relates to the shop order system used for following all foundry, forge shop, spring shop and manu-

25m-(a8m)-7-21-19 Form 1059 C
UNITED STATES RAILROAD ADMINISTRATION
DIRECTOR GENERAL OF RAILROADS

Baltimore and Ohio Railroad	Western Maryland Railroad
Coal and Coke Railroad	Cumberland Valley Railroad
Morgantown and Kingwood Railroad	Cumberland and Pennsylvania Railroad

Dayton and Union Railroad
Dayton Union Railroad

Shop Order Number 80356
Material For Lorain
Requisition N 801
Date 8-16-19
orig Foreman Finegan
Card to Isaac

COMPLETE THE FOLLOWING MATERIAL
200 Major Knuckle Pins
1 1/8 a - 12 1/2 B - 13 1/4 C
17220 E-25 G.

Pattern Number
Blue Print
Class
Completed ______ Foreman
Received ______ Storekeeper
Card No. 1 Line 7

Work Order for Individual Departments

facturing machine shop work, in fact everything except the work directly applied to the dismantling and repair of locomotives and cars, which is charged in total to individual locomotives, and passenger train and freight train car repairs, which are handled in the usual manner. A great portion of the material required for locomotive and car repairs, however, is finished for stock and consequently represents a material charge, reducing to a minimum the labor charge distributed as a blanket charge to locomotive, passenger or freight car repairs.

Shop Order Department

All individual shop orders are originated in the storekeepers' office on form 2426, original and duplicate, and

sent to the office of the assistant to the shop superintendent who is in charge of the shop order office. Monthly shop orders are used for certain regular work, i. e., brass foundry, iron foundry, spring repairs other than locomotives undergoing repairs at the shop, bolt forgings, steel car repair parts flanged, shop machinery and tools, etc. For these classes of work a regular shop order number is definitely fixed, which in reality becomes an account number. The shop order number assigned by the storekeeper is keyed to denote the month in which it is issued. This is denoted by the ten thousand group in which the number occurs, thus 10,067 is a shop order issued in January, 30,152 a March shop order, and so on.

On receipt of the material request form 2426 by the shop order office it is marked on the face with the names of the foremen of the departments upon which it is issued. The duplicate is then sent to the accountant's office and the original retained in a file in the shop order office until the shop order is completed when it is also sent to the accountant's office, properly marked, denoting the closing of the shop order.

When form 2426 is received, form 1059-C is made out to the foremen of the various departments. This card gives all information necessary to finish and deliver the work. In the event of several departments being involved, each foreman receives a copy marked over "foreman," original or copy, the original always going to the foreman completing the work, the item "card to" showing all the departments he must depend upon to perform initial operations on the material.

At the same time form 1059-C is issued, the shop order

5m 1-13-18 Rings No 440 Retainer a 15239, BP 36380 - Card #1 Form 1633-B

S. O. Number	Quantity Ordered	Date Issued	Req. No.	Number of Pieces Made and Date						Average Cost Each	Date Closed
60103	500	6-1-18	stock	36 / 6-17	68 / 6-18	101 / 6-19	134 / 6-20	167 / 6-21	195 / 6-22		
				225 / 6-23	259 / 6-25	292 / 6-25	316 / 6-26	434 / 6-27	500 / 6-29		6-29-18
10067	1000	1-2-20	stock								

Master Record Card

150M—(A50M)—4-18-18—24-34x36 Form 1124-B

THE BALTIMORE AND OHIO RAILROAD COMPANY

FOREMAN'S WORK ORDER

From Storehouse Shop To Automatic Shop

Charge 10067 Date 1-9 1920

QUANTITY	TO MAKE OR REPAIR
50	a 15239

Finegan Foreman

Work Completed ______ Workman

NO MATERIAL TO BE FURNISHED ON THIS CARD

Foreman's Order for Material for Shop Order

3000M—(a1000m)—1-25-19—24x34—150 Form 2311.

No. 3 Shop Mont Clare

UNITED STATES RAILROAD ADMINISTRATION, Director General of Railroads, BALTIMORE & OHIO RAILROAD—MATERIAL CARD.

Charge 50 10067 Date 1-9 1920

QUANTITY	Pattern No. or Size	DESCRIPTION	New or 2nd Hd	Classification	DEBIT Weight	DEBIT Price	DEBIT Amount	CREDIT Weight	CREDIT Price	CREDIT Amount
50	a15239	Retainer Rings	new					125#		

Enter on each Card Items Chargeable to One Account Only
Specify in proper column for each item whether material drawn is NEW or SECOND-HAND. F. Paullis Foreman

Shop Order Department's Material Order on Storehouse

50m-(a15m)-10-2-19 24 38 40 Form 1061

UNITED STATES RAILROAD ADMINISTRATION
DIRECTOR GENERAL OF RAILROADS
BALTIMORE AND OHIO RAILROAD
SHOP ORDER CREDIT SLIP

S. O. 10067 Date 1-8-20

Stock

50 a 15239 Retainer Rings, BP 36380

Inspected and counted by Finegan

Received at Storehouse H. Shoemaker

Form for Transfer of Material

number, quantity order, date issued and requisition number is entered on the master record card, form 2435-B.

After the receipt of form 1059-C, as the foreman requires material for the finishing of the shop order he issues form 1124-B on the shop order department, which then originate form 2311 on the storehouse and material is delivered by motor truck dispatch. A record is kept on a mimeographed form of shop order material distribution sheet assigning a serial number with suffix number for each material order issued. Thus is insured an accurate account of all material used in completing the shop order, as well as giving the accounting bureau a check, because if the last material order received bears suffix 20 and numbers 12 and 16 are missing they must be looked up before the shop order is closed.

In connection with the use of form 2311 it is interesting to know that these are safeguarded as if they were checks

Hangers-Brake Beam 7/8" x 10-7/16 N-8 BP 14681 Card #1 11603 — Form 1059-A.

Date Ordered	Amount Ordered.	Number of Pieces Made and Date									Total.
9-9-13	200	100/9-16	200/9-29								200
11-8-13	300	300/11-19									300

Master Record for Monthly Shop Orders

payable to the bearer. The number stamped at the top of form 2311 in the general foreman's office identifies the issuing foreman to whom this number is assigned. The signature used in conjunction with the identifying number must correspond with the authorized signature filed in the storehouse.

Each transfer of material from one department to another, or to the storehouse is made by means of form 1061, which must accompany each transfer and be signed in the department receiving the material, returned to the issuing department and sent from there to the shop order department. When form 1061 is received for finished material delivered to the storehouse, it is immediately recorded on the master card form 2435-B. In this way, the shop order department is continually appraised of the status of all shop orders relative to material ordered for work in progress, the status and location of work in progress and the amount of work completed to date. The foreman also keeps a daily record

Patt. No. a 15123 — Title Collar — Card No. 1

Line No.	Number Ordered	Date	Number of Castings Made and Date												Total
1	12	10/31/18	2/12-9	4/12-10	6/12-11	8/12-12	12/12-13								12
2	25	12/11/18	2/12-13	6/12-14	8/12-15	14/12-17	18/12-18	22/12-19	25/12-20						25
3	50	1/5/19	2/1-9	6/1-10	8/1-13	10/1-15	12/1-22	14/1-23	16/1-24	18/1-25	20/1-27	22/1-29	24/1-30	30/1-31	
4			35/2-4	41/2-5	45/2-6	47/5-1	48/3-3	50/3-8							50
5	150	11/14/19	Purchased on Req. a 11065												
6															
7															

Foundry Master Record

on the back of form 1059-C, so that he is also in possession of information showing the status of the shop order, until it is completed when he returns it to the shop order department signed and dated.

Forgings and foundry output are handled on monthly shop orders as previously indicated. Forgings, bolts, springs and steel car parts are ordered by the storehouse twice a month, special stock oftener. As soon as the order is received it is entered on master card form 1059-A and form 1059-B issued to the foreman. A serial number is stamped on the end of form 1059-A used for filing and ready reference. This serial number also appears on form 1059-B and form 1061, as issued.

The foundry work is also handled on permanent yearly shop orders. Each morning the storehouse advises the shop order office of castings required. Immediately form 1085 is issued on the foundry and also entered on the foundry master card. A copy of form 1085 is also kept on file in the

UNITED STATES RAILROAD ADMINISTRATION, W. G. McAdoo, Director General of Railroads.

25m. 9-7-16. Form 1059-B.

Baltimore & Ohio Railroad Co.

11-8 1913

Isaac Foreman.

Will manufacture the following material, and charge the labor and material to 244506

DESCRIPTION

Hangers-Brakebeam 7/8 x 10-7/16

N-8

11603

Blue Print 14681

Class

Completed ______ Foreman.

Received ______ Storekeeper.

Card No. 1 **Line** 2

Work Order for Monthly Shop Orders

shop order office for convenient ready reference. These cards are kept filed by weeks and unfilled cards are set back each week, so that not only do they serve the purpose of showing what is due, but also how long due. This aids in expediting the oldest orders.

The foundry is the only department where form 1061 is not used, the record of work completed here being taken from the inspector's daily record of castings delivered to the storehouse casting platform.

Accounting Department

When form 2426 is received by the accounting department, a master record card form 1195 is made out indicating not only the essential material references but also the department references.

Each day's labor distribution is taken from the service cards form 2453 Rev. being entered by departments onto mimeographed distribution sheets. As the distribution is taken off, the service card number is noted as well as the

hours and amount. Each distribution sheet is then balanced against the total hours and the amounts extended noted in pencil on the top of the service cards. Of course, it is often impossible to secure an absolute balance but the variation is kept to a minimum. The daily distributed labor charges are then entered on form 1195 back under the respective de-

UNITED STATES RAILROAD ADMINISTRATION
W. G. McADOO, Director General of Railroads.
20M—1-4-18. 28x45—190 Form 1085.

B. & O. R. R. CO.

E

CASTINGS ORDERED AND MADE

1-5 1919

Pattern No. a 15123

Pieces Required 50

Title Cellar

Card No. 1 Line No. 3

NUMBER OF PIECES MADE EACH DAY

Storehouse Order for Castings

partments. If it is found that the department does not appear as an authorized department it is returned to the shop for correction or authorization by the shop order office.

At the end of the month the distributed totals are added and the proper percentage added to cover supervision and unclassified labor charges. This percentage is based on the total of the shop orders and classified labor charges from daily distribution sheets and is the labor charge for super-

on the respective master record cards form 1195 before filing.

At the end of each month the shop expense (denoted ME) is figured and entered on the card form 1195. This is determined by taking the prorated total of unclassified shop expenses based on the previous month's labor charge for maintenance of equipment and shop orders to fix their respective divisions of the shop expense. The proportionate shop expense thus arrived at is distributed on the basis of the actual labor charge in the proper month.

Twice during the month and at the end of the month, a list of individual shop orders closed is sent to the storekeeper giving quantities, description of material and charge. All unfinished shop orders are balanced and totaled at the end of the month for clearing on the shop report.

The experience of this one road bears out the belief that cost knowledge is essential to control shop operation. The total of $1,094,825,873 for maintenance of equipment expenses for the Class I railroad during the year ending December 31, 1918, emphasizes the possibilities of even slight improvements, 1 per cent saving being $10,948,258. Cost knowledge which can only come through cost accounting and cost analysis is one of the most important agencies

SHOP ORDER MATERIAL DISTRIBUTION SHEET

SHOP ORDER NUMBER 10067 DATE ISSUED 1-2-20 REQN. NO. Stock

ISSUED ON Finegan

FOR 1000 #440 retainer rings Pat #15239

DATE	QUAN. ORD.	DESCRIPTION
1-5	50	a 15239 Retainer rings (125#) O 10066
1-8	50	a 15239 " " (125#) O 10066-1
1-9	50	a 15239 " " (125#) O 10066-3

Summary of Material Charges

that can constructively assist in bringing about improvement in railroad operating costs. The Federal Trade Commission estimates that 25 per cent of the businesses of the country fail through lack of accurate cost knowledge. Who can say how much of the present waste through inefficiency in rail-

Form 1195

COMMENCED 8/16 1919

COMPLETED 191

SHOP ORDER NO. 80356 FOR 200 Major Knuckle Pins HOW CHARGED Storekeeper

1 7/8 a - 12 1/2 B - 13 1/4 C 17220 E-259.

REQUISITION Lorain K-801 ON Finegan, Isaac SHOP

DATE		MATERIAL GROSS	MATERIAL CREDIT	MATERIAL NET	LABOR	TOTAL	DATE	AMOUNT
Dec.	19	98 40	12 00	86 40		86 40		
	19	ME 21 03		21 03	105 16	126 19		
					Bal	212 59		

Dec	Smith	Automatic	Bolt & Forge
22		7 22	
23		12 26	
26		13 73	
27		12 26	
29	1 72	8 58	1 72
30		49	
31		20 16	
Sup		3 68	
	1 72	78 38	1 72
	25	22 81	28
	1 97	101 19	2 00

Accounting Department Master Record (Front and Back)

vision, cleaning the shop, checking in and out, etc., for the respective departments.

The material charges are made up about three times a month from form 2311 summarized on a mimeographed sheet, balanced against total of form 2311 and then entered

road operation is due to the same cause? An awakened cost consciousness on the part of management is the one great hope for bettered operation; for that awakening will lead straight and inevitably to improved facilities, organization and equipment.

AMERICAN WELDING SOCIETY HOLDS FIRST ANNUAL MEETING

The American Welding Society held its first annual convention in the Engineering Societies Building, 33 West 39th street, New York, on Thursday, April 22. The morning session was devoted to society business and announcement was made of the election of officers. J. H. Deppler was elected president, J. W. Owens was elected vice-president for two years, and D. B. Rushmore was elected vice-president for one year.

A plan of action for the American Bureau of Welding for the coming year was discussed at the afternoon session. It was proposed to reduce the representation of the American Welding Society in the American Bureau of Welding. A committee was authorized to lay down a scheme of organization and to prepare a program for the coming year.

Comfort A. Adams, chairman of the bureau, spoke briefly on the subject of welded joints for pressure vessels. A point of particular interest was brought out in this in connection concerning the use of different kinds of welding machines. Mr. Adams showed that within the limits of arc length consistent with good practice in electric welding, it made no difference whether the machine used was a constant current, constant heat or constant unit heat machine.

Mr. Adams' statement was in effect as follows: In the case of the constant heat machine the current is decreased as the arc is lengthened. The constant current machine maintains a constant current for any length of arc within the limits of the machine. In the case of the constant unit heat machine the current increases as the arc is lengthened. Owing to the fact that the arc spreads out and covers a greater area as it is lengthened it is necessary to increase the current to maintain a constant heat per unit area. Theoretically this would be the ideal machine, but within the limits of arc length consistent with good practice, the variation of current is practically a negligible quantity.

The objective of the bureau's activities will be to determine how a good weld can be assured. Methods will be sought for testing the quality of a weld after it is made and for determining the best way of eliminating locked up stresses in long welds. At present the greatest hope lies in controlling the conditions under which the work is done. This will greatly reduce the amount of nitrogen in the weld. Heat treatment is beneficial in that it tends to break up the combined nitrogen.

The afternoon session was concluded by an announcement that a number of manufacturing companies have offered to assist the bureau with its research work. Much of this work is in a partially finished condition.

Speed of Metal Arc Welding

At the evening session, three papers were presented and discussed. The first paper presented was "The Speed of Metal Arc Welding," by William Spraragen, of the department of electrical engineering of the University of Washington. On account of the absence of Mr. Spraragen, who had been called away to the Pacific coast, the paper was read by E. A. Miller. In substance the more important portions of the paper are covered in the following statements:

The welding operator is a most important factor in successful arc welding and, of course, the more skillful the operator the more and the better work will be turned out. It is very desirable to be able to compute the rate at which arc welding may be accomplished, but the complexity of the different elements entering into it are such that it is very difficult to calculate the time required to produce certain kinds of joints. For inside work, 1.8 lb. of metal deposited per hour is a reasonable estimate, but when the work is performed outdoors there appears to be a reduction in the amount of metal deposited so that the average appears to be 1.2 lb. of metal deposited per hour for outdoor work. This reduction in the amount of metal deposited is probably due to the cooling action of the air.

With reference to the type of welding apparatus used, whether it be alternating current apparatus or direct current apparatus, it is estimated that where first class welding operators are employed there is no difference in the speed between the two kinds of equipment.

In a few words of explanation the retiring president, Comfort A. Adams, explained that the paper on the speed of arc welding was based upon conclusions arrived at by tests made by the General Electric Company in welding up some 10½ tons of welding material. This work was done just prior to the signing of the armistice and while the work had been cut up into coupons, ready for testing, the tests have not been made up to the present time.

Automatic Arc Welding

The second subject for the evening was "Automatic Arc Welding Machines," by H. L. Unland, of the Power & Mining Engineering Department of the General Electric Company. Mr. Unland stated that the automatic control of arc welding was not new. He said that the automatic arc welding machine had been developed for the reason that it was desirable in turning out large quantities of duplicate parts to make this operation as nearly mechanical as possible. As a precedent he mentioned that years ago the General Electric Company had developed a similar machine for a gas cutting process which was used in the making of small gears, wheels, etc. Operators, cutting by hand, frequently ran over the line; these factors influenced the company to take up the question of mechanical feed and a satisfactory cutting torch was eventually produced. At that time it was found that the gas consumption was reduced to one-third and that the speed was increased four or five times over hand work.

The development of the automatic arc welding machine is merely an extension of the same principles into another field and for sections that are being turned out continuously the mechanical feed is the proper thing to use. Mr. Unland described the General Electric machine and with the aid of numerous stereopticon slides explained very carefully the operation of the various circuits used in the control of the welding wire to the work.

Gas Cutting

The third paper on Recent Development in Gas Cutting, by Stuart Plumley, of the Davis Bournonville Company, was not read, but Mr. Plumley spoke briefly of the more important developments. The most successful development has been the cutting of cast iron with the gas torch. Cutting cast iron is particularly difficult because the oxide of iron melts at a higher temperature than the iron itself. The cutting is now accomplished by preheating the oxygen.

It is so easy to break cast iron that gas cutting is not often desirable, but it can be used to excellent advantage for such operations as cutting a frozen blast furnace cap.

Discussion

The discussion brought out the fact that the rigid method was used for welding tanks with the automatic electric welding machine. The statement was made that locked-up stresses were greatly reduced by reason of the fact that the speed of welding was very high. It was further stated that alternating current cannot be adapted successfully to automatic welding as a sensitive variable speed motor is required for feeding the metal into the arc.

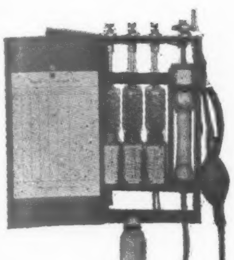
Training of welding operators with the alternating current arc was advocated on the ground that because the alternating current arc had to be held within closer limits, the welders trained to use the alternating arc make better operators than those who receive their initial training with the direct current arc.

ECONOMY AT STATIONARY BOILER PLANTS

Some Loose Practices Common to Railroad Boiler Plants and What May be Done to Correct Them

BY C. M. ROGERS*

Service Manager, Locomotive Firebox Company, Chicago



THE operation of stationary boiler plants has been brought under the scrutiny of government, owner and manager in the past few years on account of a sudden well-founded realization of plant inefficiency; that in their condition as found they represented a tremendous drain upon the treasury of the operating concern, and that in the main they have fallen behind other institutions in the swift race of progress. It was also realized that these conditions could be remedied by an expenditure of time or money, or both, that would be quickly repaid by the economy effected.

The boiler plant is a producer, and should be so considered. Experts working on shop management are interested in increasing shop output and reducing cost of manufacturing their product, money is freely spent in every way imaginable upon shop improvements and much time is devoted to the study of shop methods. Production is right next door to the manager of a manufacturing establishment and is the object of his closest attention. It haunts him. The production of power required to operate a shop is obscure. Usually power is obscurely transmitted to the shop. The boiler plant is nearly always placed in a location separate from the main shop. The manager usually is appointed to his position because of his knowledge of shop work, and these men have seldom had occasion to familiarize themselves with the construction, operation and output of a boiler plant. Because of this obscurity and the concentration upon shop output, stationary boiler plants, as a rule, have been permitted to worry along with little attention until they are almost exempt from consideration as producers and are classed as a necessary evil. From the standpoint of production, they have been separated from the work of the shops to which they deliver power. As a result of this attitude plants are usually found in poor physical condition and employees assigned to operate them are not trained to a very high degree unless they have sufficient initiative to inform themselves and thus advance the interest of the company by improving operation as far as possible through their own efforts.

This general attitude exists towards plants up to 1,000 boiler horsepower. In recent years boiler plants of great capacity, representing the investment of huge sums of money and requiring large expenditures for fuel and other supplies, are receiving the most minute attention to maintain them in the best condition and to operate them as economically as possible.

A stationary boiler plant is fundamentally designed to bring together air and fuel in such a manner as to create combustion, the heat from which is to be converted to power through the medium of water. In order to maintain combustion the application of the ingredients must be controlled. To control the air the boiler is surrounded by a casing such as a brick setting. The fuel is controlled by the operator, either by hand or by mechanical means. As control of the air supply is essential, it should be made absolute by having the setting air tight in every respect. Air should be admitted to the fire principally through the grates, so that proper mixture of the ingredients may take place. After going to the expense of providing facilities for burning fuel it is folly to permit cold air to sweep through the chinks in a poorly maintained setting to reduce the temperature of the products of combustion, thereby losing heat that would otherwise be absorbed by water in the boiler. Admission of the proper proportion of air under the best conditions is very inaccurate, but when cold air is permitted to pass through the brick work and other crevices the resulting losses amount to a larger percentage.

Plants may be found today where the operator controls the supply of air by means of the ash pit doors alone, leaving the smokestack wide open to emit large quantities of heat. If corrected he states that with the ash pit doors closed there is no pull through the fire, consequently the heat will not be lost. At the same time his setting is without plastic cement, brick work is full of small cracks and the fire doors do not fit. The head of air produced by the difference between atmospheric pressure outside the setting and a partial vacuum inside causes cold air to stream through these openings, cooling the gases and carrying heat off through the stack. Firemen and others are familiar with the use of a damper in the stove pipe at home, and they realize that to leave the damper open at all times is a wasteful practice which is directly reflected in the amount of their fuel bills. A damper in the breeching or smokestack of a boiler plant performs the same function as the stove damper, but the men in charge fail to realize this fact and drift along sometimes for years baling in coal during periods of light as well as heavy load.

One can find many plants equipped with stack dampers, but the fireman doesn't know they exist, not to mention the fact he does not use them. There are stack dampers installed in such a manner that it is necessary to get a ladder to climb up on top of the setting in order to adjust them; then they are usually found to be inoperative. Damper operators should be simple, easy to operate, arranged for close adjustment and located at the position where the fireman works—at the fire door—so that he can make frequent adjustments to suit load, fuel and other conditions. The fireman should be shown that by utilizing the damper his labor is reduced and he saves on the fuel bill. When he once proves this fact to his own satisfaction he will use his mind to save his muscle and ever after will be a booster for any project intended to save coal.

As a rule firemen are too industrious. They shovel coal as a matter of dull habit and seem to be contented with handling large quantities of fuel, with no thought of the various methods of helping themselves by reducing the quantity.

Most plants have variable loads. Some of them are required to respond to quick changes of load in rapid succession. Others perform to their capacity during the day shift and are to a large extent relieved during the night shifts. Still others have the load reduced to such an extent during the night that fires may be banked. The writer has in mind a pair of hand-fired boilers totaling 400 hp., which were without stack dampers and were operated with the ash pit doors wide open at all times. Every afternoon at four o'clock the load is reduced about 75 per cent; but the ef-

* Mr. Rogers was formerly supervisor of stationary boiler plants on a western railroad.

forts of the fireman to keep up steam were reduced only about 15 per cent; the difference gives an idea of the amount of fuel being wasted. After dampers were installed a thorough demonstration of the possibilities of damper regulation of draft was made for the fireman on each shift and instructions given to follow this practice for a while to determine for themselves its value. Looking in on the fireman on duty at five o'clock one afternoon about a month later, both dampers were found in nearly closed position, the place cleaned up and the fireman spending most of his time lounging on a "lazy back" smoking a pipe. He was fully convinced that dampers were an improvement and was quite elated over the reduction in labor he had to perform. The CO_2 content of the flue gas at this time averaged 13½ per cent, which is a good figure for a plant of this kind.

If the damper is operated automatically by an effective appliance the very best results may be obtained. Such an operator should, if possible, be controlled by the pressure of air within the furnace, thus admitting only the required amount of air for proper combustion. An average of 15 per cent CO_2, representing perfect combustion, is possible with such an appliance.

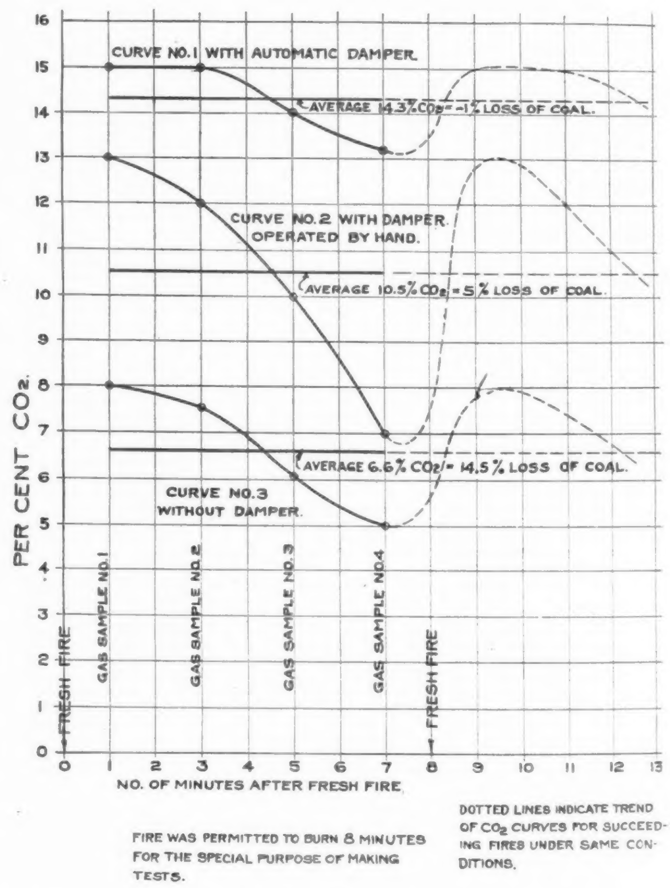
The owner of a plant is under obligations to install suitable equipment and appliances if he expects his employees to become interested in economical operation, and once installed, co-operation should be expected of the men. The best way to get next to the men is to don the uniform of the fireroom and demonstrate the truth of your instruction by doing it yourself, if you can, to prove it. A supervisor wearing a white collar cannot overcome the deep-rooted though misplaced conceit of most firemen that they know all about the game. Actual demonstration of how the job should be done, reinforced at times by a little authority, will convince them nearly every time. There are some old timers who have followed the game too long in the same old way to change their habits. These men should be given less important work if they cannot progress.

The use of a portable gas analyzer will accomplish a great deal in educating firemen. By the use of this instrument the writer has convinced many firemen of the error of their methods. At the outset an explanation of how the instrument makes its simple analysis should be made; this arouses interest. A series of tests with the damper in various positions, with fuel bed in the same condition, indicates the kind of combustion they are getting. The important point is to find the position of the damper that will result in the highest percentage of CO_2 (carbon dioxide), at the same time maintaining the required steam pressure and avoiding excessive clinker adhesion to the grates. Using the boiler front or other convenient surface as a blackboard, the results should be chalked up for a lasting impression on those interested. If, with the damper wide open, analysis indicates a content of 6 per cent CO_2, the 17 per cent preventable waste of fuel should be shown, next the corresponding amount of coal in tons based upon the monthly consumption, and then the cost. If, with the damper partially closed, the CO_2 content of flue gas is raised to 11 per cent, the reduction of preventable waste to about 4 per cent should be noted, and if the plant can maintain working pressure with the damper closed to a position that will average 13 per cent CO_2, representing a preventable waste of 2 per cent, the firemen will properly be impressed, and by prolonging the test they will soon notice the effect upon the amount of labor they expend. If they fall into line they should be suitably commended.

Men who shovel coal as an occupation do not look upon fuel as a costly substance. They see it all day long day after day, ton after ton, until they have a subconscious idea that coal is the cheapest and most plentiful commodity in existence. There is need of disillusioning firemen on this point. The present cost of fuel requires the expenditure of time and money to save it.

A good gas analyzer may be depended upon to furnish accurate analysis of combustion conditions and serve to trace promptly the cause of preventable waste. Gas analyses, however, do not indicate boiler efficiency, which is affected by scale, soot and other factors. The CO_2 content of gases simply indicates the proportion of air and fuel in the products of combustion.

The accompanying chart illustrates one series of four gas analyses for each of three different boilers taken during a period of eight minutes between applications of coal, showing comparison between boilers equipped with automatically controlled damper, hand-controlled damper properly used, and boiler without damper. It will be noted the preventable waste of fuel due alone to improper combustion ranged from less than 1 per cent on the boiler with automatically-controlled damper to 14.5 per cent on the boiler without damper. Based upon a monthly consumption of 1,200 tons, this is equivalent to a loss of from 12 tons of coal per month on the one boiler to 174 tons on the other. These examples were taken at random from plants similar in size and are typical of results being obtained at many stations.



Effect on Flue Gas Analysis of Proper Use of Stack Damper

Curve No. 1 shows the percentage of CO_2 as analyzed from the gases taken from a boiler controlled by an automatically operated damper. It may be noted that one minute after fresh coal was applied to the fire, CO_2 was 15 per cent, and as this coal burned out, the percentage gradually reduced until at seven minutes the CO_2 was 13.3 per cent. The average CO_2 content for this curve is 14.3 per cent, or less than 1 per cent preventable waste of fuel.

Curve No. 2 indicates the trend of CO_2 readings for a like period on a boiler controlled by a damper in the stack operated properly by hand. The CO_2 dropped from 13 per cent to 7 per cent, making an average CO_2 content for this curve

10.5 per cent, which represents 5 per cent preventable waste of fuel.

Curve No. 3 indicates a series of CO_2 readings for a like period of a boiler without a damper of any kind, from which it may be noted that the first gas sample analyzed 8 per cent CO_2. This diminished to 5 per cent for the fourth sample at seven minutes, making an average of 6.6 per cent CO_2, or 14½ per cent preventable waste of fuel.

EFFECT OF PROPERLY OPERATED STACK DAMPERS ON CO_2 CONTENT OF FLUE GAS

		CO_2 content: per cent						
	Curve No.	Gas sample No. 1	Gas sample No. 2	Gas sample No. 3	Gas sample No. 4	Av'ge.	Preventable waste.	Fuel wasted from this source in a plant using 1,200 tons coal a month.
Automatic damper	1	15	15	14	13.2	14.2	1	12 tons
Hand operated damper	2	13	12	10	7	10.5	5	60 tons
Without damper..	3	8	7.5	6	5	6.6	14.5	174 tons

A big organization such as a railroad owns many stationary boiler plants. Because of separate supervision and for other reasons, such plants are seldom in like condition, and on account of the distance from one to another comparisons are difficult to make. There is, however, a friendly rivalry between employees of the various plants, and the writer has often been asked by the stationary engineer how the physical condition of his plant compared with other plants on the road. In order to satisfy this demand a report was made up showing the rank of the various plants being supervised, as determined by inspection. To arrive at a fair rank, a percentage allowance based on relative importance was made for each item, such as condition of boiler setting, presence of dampers, scale, soot, steam and air leaks, pipe insulation, interest of local forces in the plant, effort to follow instructions, etc. The total of all allowances was 100 per cent and rank was reached after deduction on all items not up to their allowance. The report bore the name of the location of each plant, with its rank. This report was sent to all concerned from general officers of the road down to the plant engineer. The report served its purpose. The fellows who found their plants down around 30 per cent and 40 per cent felt the sting of comparison with plants ranking 92 per cent, and they promptly began to make the improvements which it had otherwise been impossible to secure. One plant of 400 hp., on which considerable time had been expended in trying to arouse interest in its improvement without result, rose from the rank of 30 per cent to 82 per cent in 30 days after the first of these reports was issued. The results were so gratifying that it was issued at regular intervals until the plants were in the best physical condition possible under existing circumstances.

As a rule the boilers are the most uneconomical units in the power house. There are instances where plants are equipped with expensive turbo-generator sets, compressors and other engine-room equipment which are maintained year after year in first-class condition, while the boiler equipment in the next room is permitted to deteriorate. That this difference continues to exist is an absurdity, but it does exist in many cases. On railroads expensive facilities in the form of engine houses and repair shops are erected, manned and maintained, very properly, for the purpose of keeping locomotives in good, efficient, economical condition. In contrast with this practice the proper maintenance of stationary plants is neglected or ignored until after a few years' service, when it suddenly fails to perform its natural function. This contrast should be corrected, to the advantage of the boiler plant. It is cheaper to repair a plant when repairs are needed than to allow defects to accumulate.

Other features of maintenance and operation are fully worthy of consideration. Surfaces which waste heat by radiation should be insulated. The use of exhaust steam to heat feed water is so commonly practiced that it need only be mentioned. It is important, however, to keep feed water pumps moving continuously but as slowly as necessary, thereby maintaining the highest temperature possible with the steam available. Baffle walls should be kept tight to prevent the short-circuiting of the gases. Air, steam and water valves and connections should be kept free from leaks and the plant engineer should make regular inspection for these defects.

Scale and soot on boiler tubes offer great resistance to the transmission of heat to the water. Flues should be rattled or bored frequently enough to keep scale knocked off. Soot should be removed by dry steam or air at least once on each shift. A good mechanical soot blower is one of the most economical and satisfactory devices around a boiler plant. Every boiler should have one.

There are other features about a boiler plant which affect economical operation—too many to be covered by one paper. If all concerned in the operation of a plant are made to realize the good results it is possible to obtain and enthusiasm is created in working out the possibilities one by one, the defects will be overcome, with the result that the employees will be better satisfied with their work and economy will come into its own.

CANADIAN PACIFIC TO EXTEND ANGUS SHOPS

In order to speed up on the construction of equipment required on the Canadian Pacific large extensions are being made at the Angus shops in Montreal. These extensions will cover a quarter of a million square feet and are expected to cost approximately a million dollars. The largest addition will be made to the passenger car shops, amounting to 71,000 sq. ft., while over 58,000 sq. ft. will be added to the locomotive shops and 42,400 to the freight car shops. The following are the detailed particulars of the extensions:

Locomotive Shop.—The extensions to the locomotive shop will consist of an addition at each end of the present shop to give an additional floor area of 58,000 sq. ft. The construction will be steel frame with concrete foundation and brick walls. Mastic floor will be placed on the west end extension and wood block floor on concrete in the east end extension. The east shop extension is to be used as a running shed, and for this reason pits with mill type smoke jacks will be installed. All of the skylights will be constructed of wood and mill type ventilators will be used throughout this shop.

Freight Car Shop.—The addition consists of an extension to the present building at the west end, 106 ft. wide by 400 ft. long, giving an additional floor area of 42,400 sq. ft. The construction will be steel frame with concrete foundation, brick wall, wood floor and roof similar to the present building.

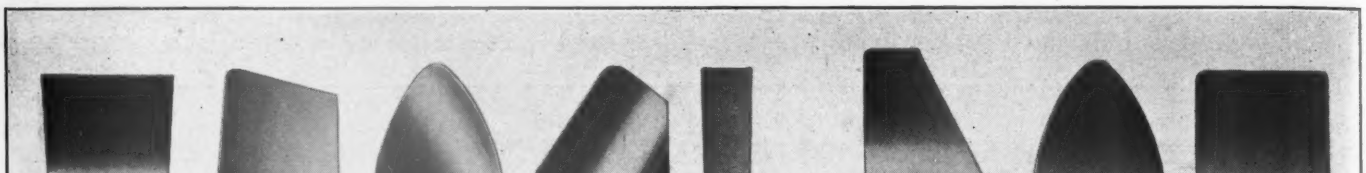
Pattern Storage.—This shop will be extended at the west end 75 ft., and will be 50 ft. in width, and a three-floor fireproof building. The construction will be steel frame with concrete foundation, brick walls, steel sash, concrete roof and floors.

Passenger Car Shops.—The new work consists of an extension 102 ft. by 161 ft. between Shops 2 and 4, and 137 ft. by 161 ft. between Shops 1 and 3; and a 137 by 239 ft. east end extension of Shop 3, giving a total increased area of 71,000 sq. ft. The construction will be concrete foundation with brick walls, mill type roof, concrete and mastic floors.

These shops will be all served from the present transfer table, the pit of which is being extended.

Car Electrical Shop.—This is a new building 62 ft. wide by 362 ft. long, giving a floor area of 23,000 sq. ft. The construction will be steel frame with concrete foundations, brick walls and acid proof mastic floor.

There will also be built a new planing mill shelter, an addition to the dry kilns, a high capacity track scale and a 50-ton coaling plant.



Tools Ground Direct from Bar Stock

PRODUCTION OF LATHE AND PLANER TOOLS

Grinding from Bar Stock an Economical Method of Manufacture; Centralized Tool Service Advantageous

BY E. G. BLAKE
Sales Engineer, Alfred Herbert Ltd., New York City

A REVIEW of the progress made by grinding as an economical method of removing metal shows a somewhat surprising number of engineering firms still making lathe, planer, shaper tools, etc., by the old fashioned method of hand forging. It is with the thought in mind of pointing out that grinding may be substituted for this method that the following is written.

Comparative Costs

The writer has no data available on the cost of forging tools, but the practice is so well known that it will only be necessary to give an idea as to the cost of grinding to leave no doubt as to the comparative cost of the two methods. Means are available today whereby a tool of any desired shape may be ground from stock of 1-in. by ¾-in. section in two or three minutes according to the shape, and other sizes in a proportionate time. It probably would take a blacksmith more than two minutes to heat the steel before he and his helper commenced a similar job. Hand forging is at best a rough and inaccurate method of producing any desired shape and carries with it the danger of maltreatment due to the hammering of the steel above and below certain heat limits. It is a well known fact that a large amount of high speed steel is ruined through bad heat treatment in the forging operation, and any method which tends to eliminate this waste should be considered. The grinding of tools from bar stock should, of course, be performed dry and the tool hardened afterwards. It will readily be understood that a tool ground on a machine especially adapted for this purpose to a predetermined shape requires very little regrinding after the hardening operation, whereas a forged tool needs to be corrected on a tool grinder or by hand to gages, and the cost of this is more in itself than that of the rough grinding operation on a machine specially adapted for the purpose. Add to these two costs that of hardening and we have a cost about one-sixth of that of forging and subsequent grinding.

Effect of Grinding on the Steel

Bearing on the question of forged tools a paper was presented as recently as December 19, 1919, by G. W. Burley of the University of Sheffield in London before the Institution of Mechanical Engineers. Mr. Burley headed his paper "Cutting Power of Lathe Turning Tools," and stated that the shape of the nose of the tool which was adopted as the standard in the original investigations is such that it can be obtained from a plain bar by the single process of grinding, but that in the case of the majority of shapes it is necessary to have the nose shaped initially by forging and finished by grinding. It appeared desirable, therefore, to determine whether this initial forging operation had any influence, deleterious or otherwise, on the quality of lathe turning tools. After giving details of the test bars forming the subject of this test, Mr. Burley stated that the results of the trials demonstrated that there was no appreciable difference between the cutting power of a forged turning tool and that of a similar unforged one provided that both tools are made of the same kind of steel and passed through the same hardening process. An excerpt from the paper follows:

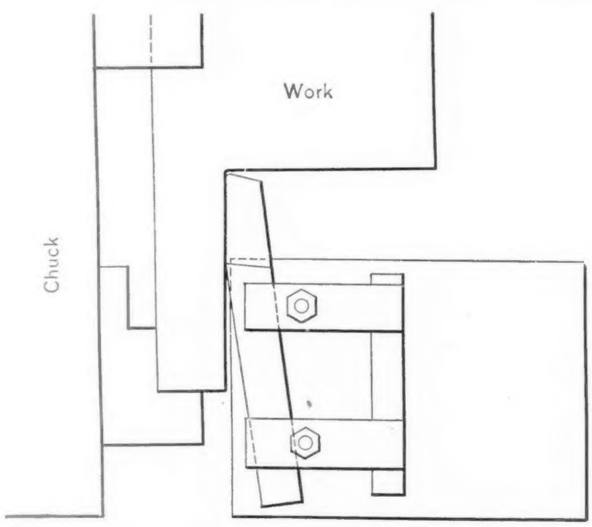
"This conclusion has been confirmed by results obtained incidentally from an extensive investigation which was made on tool steels as a special war research in the University of Sheffield. In this investigation nearly 1,000 individual tests were made on 332 tools of similar shapes under identical conditions, one-half of this number having forged noses and the other half unforged ones. An analysis of the results of the investigations shows that the two kinds were fairly evenly divided, practically one-half of the tools of each kind giving results above the mean, and the other half below with an average superiority of not quite 0.25 per cent in favor of the forged tools."

It would appear that the difference between forged tools and tools ground from bar stock, is negligible, and this information coming as it does from an authentic source should be particularly appreciated in view of the shortage of skilled

toolsmiths existing at the present time. This apart from the fact that experiments have shown that tools can be produced from bar stock by grinding much more economically than by the old time method of hand forging and grinding.

How Grinding from Bar Stock Affects Tool Design

Previous discussions on the subject of tool design have taken for granted that grinding is a long and laborious operation, and therefore the greater part of the remarks have been devoted to tool forging to be done in such a manner that subsequent grinding should take as short a time as possible. Due to the progress made by grinding, some thought should be put into the question of tool design, with a view to taking advantage of the many economies which can be effected by the grinding of tools from bar stock. Bent and offset forged tools are very often used without any thought as to why they should be bent or forged, although it is generally known that a bent tool is not so efficient as a straight tool, as the pressure on the bent tool is inclined to tilt the tool sideways owing to the width of the tool shank acting as the clamping base, whereas the straight tool takes the weight of the cut somewhere near the center of the section, which gives a support from the full length of the tool shank.



Tool Ground from Straight Bar Stock Applied to a Lathe.

The illustration shows the application of a tool which has been designed to substitute for the offset tool which is costly to forge, weak when made, and is soon rendered useless by regrinding, while the straight tool is stronger and has considerably longer life, as it will stand much more regrinding. This is a typical instance of what can be done with a little thought, bearing in mind the economies attached to the principle of grinding from bar stock. Almost any job can be handled in the same manner.

Toolholders—Butt Welding

Substantiating the statements as to the costly method of tool forging is the growing tendency to use tool-holders and tools with welded or brazed tips. It would appear at first that the use of tool bits and toolholders is economical, but our observations have shown us that this is not the case. Certainly the question of initial expense is in favor of the toolholder proposition, but when it is considered that only approximately 60 to 70 per cent of the steel purchased in the form of tool bits is actually used, it puts a different aspect on the case. All points considered, this latter feature seems to us very convincing, for, while the initial expense in purchasing tool bits is small, when the total purchase of high speed steel is taken into consideration and deducting from 30 to 40 per cent as absolute waste, it would appear that any other method which would reduce this waste should be considered.

The same argument applies to tools with brazed or welded bits. The life of these is very much limited because of the tip wearing in thickness due to regrinding. It is not logical to expect a tipped tool to last until the regrinding reaches the bar stock; therefore it is safe to assume that the same waste occurs as in the case of toolholders. In addition it is quite an expensive process to make the tipped tools in the first place. Using solid stock as an alternative offers very little better results owing to the fact that considerable waste is experienced when the bar stock becomes too short for use. A solid tool has, of course, the great advantage of being the best type for absorbing the heat generated by the cut, and consequently stands up longer. Our observations show that butt welding high speed steel to a carbon steel shank is the only way in which the full advantages of the solid tool can be obtained without the waste entailed by the use of toolholders and tipped tools. By welding a piece of high speed steel, one-third of the desired length, to a piece of low carbon steel of the same section, a tool is obtained which has the very desirable features of the solid tool and can be used by regrinding or reforging right back to the weld. Further, by using the high speed steel piece one-third of the desired length, the high speed steel portion of the tool itself has the necessary support afforded by the tool rest without the strain affecting the joint. This method is worthy of the consideration of anyone interested in the economical production of high speed steel tools.

Centralized Tool Service

Centralized tool service has often been considered, but very little progress has been made in this direction. No one seems to doubt the advantages that such a service offers, but one of the reasons why this method of making cutting tools in a shop is not adopted is because of the undesirability of having a blacksmith's forge connected with the tool-room. If the forging method was superseded by grinding, the necessary machines could be installed in the tool-room and would not interfere in any way with the organization in that department. In many engineering works the design of cutting tools is in the hands of the machine operators themselves, which results in a larger number of standards than is necessary and a consequent larger number of tools lying idle. Great economies can be effected by altering this state of affairs. In the first place the number of standards could be reduced to a minimum and a constant supply of tools always be available in exchange for dull or broken ones. This would also mean that the operators would spend less time at the grinding machine while their own machines were lying idle. Tools being ground to certain standards, assuming that these standards have been found to be the most efficient for the purpose, would consume less power in operation and would stand up to the work longer.

HERBERT SPENCER.—It may prove interesting, if not something of an inspiration to railroad men to know that Herbert Spencer, the greatest philosopher of modern times, began his career as a civil engineer on the London & Birmingham Railway. He was employed on this railroad and the London & Gloucester Railroad from 1837 to 1846, and according to his biographers was a very good engineer. In 1848 he became a sub-editor on The Economist and in 1850 published Social Statics, his first notable book on philosophy. The one hundredth anniversary of Herbert Spencer's birth was celebrated April 27. He was born at Derby, England, of Methodist and Quaker parentage. His father, who was a schoolmaster, did not have the means to send him to college, but his uncle offered to send him through Cambridge. He declined this offer, however, and chose to begin his career in railroad service.

HOW THE MASTER MECHANIC INCREASED PRODUCTION*

Better Mutual Understanding and an Appeal to the Sporting Instinct of the Men Brought Results

BY E. F. JONES

JACK BRADLEY, Master Mechanic of the Big Shops, sat deep in thought. From all sources came the insistent cry for increased production, but there was no response. Everywhere he saw signs of restlessness. He, too, felt the daily surge of new and powerful emotions. The terrible strain of war with its great griefs, had, with the signing of the armistice, left the human family in a high fever of nervous reaction. He knew that it must run its natural course, but that ways must be found to keep it within due bounds. Humanity was on the march. Old ideas and customs had been torn loose and cast aside. Men who faced death in the trenches had come home with a new conception of life and were not content to pick up the threads of civil life where they had left them at the call of duty.

Walking through the shops that morning, Jack had looked at the men more keenly than usual. What were the thoughts and the feelings of these men who made up the working force of the big shops? Their state of mind showed in the apathetic manner in which they performed the various jobs. The atmosphere was comparable to a damp day. Coming back to the office he took particular notice of a swarthy Italian laborer doing a heavy lifting job. Although strong and robust the man worked in a listless manner. Walking up to him Jack said "Good morning, Tony," and asked a few questions about sunny Italy. Instantly Tony straightened up and saluted. With intense and passionate feeling he told of the land of his birth, of the suffering brought to his people by the war. His dark eyes shone eagerly and brightly as he told of his active war service and his voice grew a little husky as he visioned again the loss of his boyhood friends.

After Seeing That Everyone Was Comfortably Seated, Jack Started Slowly and Carefully to Explain the Object of the Meeting.

Several minutes later Jack looked out of his window and saw Tony working with new spirit and energy. He had gently and delicately touched the human chord in Tony's nature, and released a pent up flood of feeling. A little tangible personal interest had made Tony a happier man. He knew that the same chord struck with a rough hand would have produced a rasping discord. Why did the human family realize that years of study and training were required to bring out the tones of harmony in musical instruments, and neglect entirely the training that would bring harmonious response from the most wonderful instrument of all—the human body and soul?

Thinking deeply of this little incident Jack glanced at his desk covered with letters and reports. He knew without looking through the mass that not one letter or report dealt with the human factor of the big shops in a broad constructive way. Thinking back through the years past he realized that all the improvements for the men's comfort and health had been carried out according to a state or federal law, and none through the company's desire to make the workmen healthier, happier and better men. He realized deeply how production had suffered by this short-sighted policy, and determined, so far as was in his power, that not another day would pass under such a policy.

Calling in his chief clerk, Jack asked for a meeting of all foremen at one o'clock. As the word passed around it caused some wonderment, as a meeting had been held several days previously, and it was a very unusual thing to hold another so shortly. Promptly at one the foremen trooped into the big office of the master mechanic. They did not perceive the keen look bestowed upon them by "the old man," but it was the same look he had used in his walk through the shop that morning.

Jack felt a new sense of appreciation and confidence as he closely studied the faces of these foremen who had gone through many hard days and trials with him. As his eyes rested on the general foreman he felt a chill of apprehension. Here was a man of the old school who had won his position by his ability to drive and lash men in their work. He was of the bulldog type in build, manners and speech. In the presence of the master mechanic he was servile; in the presence of the men, domineering.

After seeing that everyone was comfortably seated, Jack started slowly and carefully to explain the object of the meeting. He told of his own feelings through the war period and the unrest he had felt in the days following. He told of the surging unrest of the whole world, and the need of meeting this condition face to face and in man fashion.

"We have got to play the game under new rules," said Jack, "and here they are. Our policy as supervisors has been to drive and dictate. We have reaped a crop of distrust and resentment. We are all together at this shop, yet it reminds me of a house with two rooms and both in darkness. The men in one room and we in the other are each planning new ways to get the better of each other. Neither can see what is going on as the darkness of secrecy and distrust is too intense. It is our duty to clear our room of this darkness and invite the men into a clear atmosphere of understanding and trust. This move will breed suspicion at first and we must prepare for rebuffs and disappointments. The clear light of our room however will soon work its cheerful power over the men, and they will gradually step in and look around furtively for the nigger in the wood pile. Frank discussions and above-board dealings will be the order of business in that newly lighted room, and soon those men will realize that we are doing our best to play square and

*Entered in the Railway Mechanical Engineer's prize story contest.

will go back to their dark room and tell their story of the new rules. The atmosphere of their room will gradually change to light and cheer. We then have a well-lighted cheerful house with free and friendly interchange of thought. This is the theory and our duty is to work it out in a practical business manner.

"Our first step is to interest the men in the work of these shops as a whole. They know nothing of our month's program, and never hear of their good work. We take the credit for that. When things go wrong, they hear of it through a 'bawling out,' which is frequently accompanied by curses. Every curse robs the treasury of this company by adding bitterness to the man's soul. A man in this mental state has a vicious desire to strike back and usually does. This striking back takes the form of destroying material, loafing, and other ways which only a bitter-minded employee can think of. The commonest expression of these employees is 'To Hell with it!' Curses and lack of humane interest on our part were the seeds which brought forth this terrible crop of destructive spirit.

"We have got to realize, men, that we reap what we sow and the man who sows must be responsible for his crops. Our new seeds are to be manly language and humane interest, and the crops will be good will and concentrated effort to please. We have hammered the men for years to increase production and the net results of constant hammering are a decreased production. This proves our failure and only stubborness and willful blindness will keep us on the rutty road of failure, when there is a broad, smooth highway nearby, leading to success.

"Results count, not misdirected efforts. Over there hangs the engine program board. I see it every day and so do most of you, but the men seldom see it, and know little of its use. Tomorrow the board goes into the shop and its purpose will be explained to every man. We will show how it keeps us informed of our monthly allotment of work and keeps us posted on our progress. We will keep this progress record in a way that all can read and understand quickly and easily. A graph board of 31 days will be placed next to the engine board. A bold straight line running from the lower left corner representing the first day of the month, to the upper right hand corner, representing the last day, will be the guide to show our anticipated daily progress. What is actually accomplished will show by a different colored line. This line will constantly remind the men if the shop is falling below the line of real effort, or is going above the line and keeping above.

"The natural instinct of man will make him fight to get above the line and a natural pride will be felt as he sees his efforts pictured in a way that means some real accomplishment. We have 172 engines assigned to this shop and to most of us they represent merely big pulling machines. They are a great deal more than that. They represent the mental and physical labor of hundreds of men and the finished locomotive remains the living part of what those men gave. It accomplishes its daily task successfully or otherwise, according to the quality of labor that made it a productive factor. Every day a large bulletin board will contain the performance record of each engine. Each man will be eager to see his workmanship stand the test. If a failure occurs the exact cause will be briefly explained and if due to faulty workmanship, the failed part, or a rough sketch of it, will be put on view for one day, under the number of the engine.

"No criticism will be needed, as the defective part will tell its own story of neglect or carelessness more effectively than words. This mute object lesson is not given to shame the employee for his neglect; its object is to educate and to teach its lesson in a way that reaches deep into the man, and awakens his sense of responsibility, showing him what a vital part he is of the entire organization. A new and powerful interest will be awakened in that man and its lesson will react on the other men as they will picture importance of their work and realize that they must not be the weak link in the chain.

"After these new policies have awakened the interest of the men, we will ask them to re-name their grievance committee, as that name suggests improper relations and discord. I will suggest the committee be named conference committee and its object will be to promote harmony, good will and confidence and to talk over all shop conditions in a big constructive way. We must educate our men to the point of view where they will begin to suggest economical ways of operating. If they say a certain part of the work can be expedited by making certain changes, and we cannot

"Red, What Do You Think of Our New Policies?"

agree, we will give them an opportunity to prove their point. This action on our part will make them very eager to show they are right and it will place a burden of responsibility on them which will broaden their vision and have a good effect on their future suggestions. Giving a workman the viewpoint of personal responsibility and creative opportunity to work out his own ideas on a job will improve his mental health and strengthen his loyalty. He keenly relishes the idea that he is a recognized factor in our shops and will respond vigorously. A man with this spirit will swing his hammer with twice the force, and oftener. Mental health is just as important as physical health in all our efforts. When you get this fact honestly worked out, the problem of increased production is solved, and it is the only solution."

Jack paused, and then slowly said, "Men, are you with me?" He had read his answer during the pause. Their faces already reflected the new spirit and their spontaneous assurances gave Jack high hope.

The general foreman sat red-faced and bewildered looking, and as the men left his office, Jack asked him to remain and said, "Jim, you don't agree with me on this, do you?", and Jim blurted out, 'Hell Jack, I'm no Sunday school teacher." Jack replied, "No, Jim, this is a man's job. Times have changed. It's the way of the world. Nothing stands still. We must go forward in step with the new conditions or drop out of line. It's going to be hard on you, Jim, but I want you to give the new rules your best efforts."

The general foreman left the office without comment. As the days and weeks went by, Jack felt the gradual improvement in the shop's pulse, and knew that the new medicine was taking hold. This improvement was slow and there were relapses. Jim, the general foreman, could not play the new game, and sent in his resignation.

One day a department foreman came to Jack and stated that he would have to fire one of his best men who was agitating continually and telling the men that a crooked game was being played by the management. This man was a natural rebel and leader, and Jack knew he had great influence over the other men, so he determined to convince him that the game was straight. Calling him in later in the day, he said, "Red, what do you think of our new policies?" Red was a little confused but shot back, that the management was "pulling the wool" again.

Starting in earnestly and slowly, Jack detailed the changes that had come over the world, and how imperative it was for everyone to play square. He surprised Red by admitting that the higher officers had made many mistakes in dealing with the men, and said most of these mistakes were due to their lack of contact with the men. Men who were out of actual contact did not understand each other's problems. "We are going to get closer together in this new game and we want you to play fair just the same as you would in a game of baseball. The only difference between baseball and business is that business is played by everyone and the most interesting game in the world if played on the level. What would you do to the fellow in a baseball game who continually tried to cut his corners or spike the basemen, and hollered murder when he was caught?" Red instantly answered, "I'd break his damn neck." "Well," continued Jack, "that's what is going to happen to all the crooked players in this game of business. Clean business will not tolerate crooked players, and they will be put out of the big game, and some of them crippled so they can never play again."

Red's interest was awakened and his manner changed.

A Shrill Boyish Voice Called "Hey Jack, How's Your Golf"

The earnest, sincere way in which Jack pictured the game, appealed to Red and he eagerly began to suggest ways and means of improving the shop work. For a full hour they went over various phases of the work, and Jack learned more in that hour than he had in a month's inspection. The ingenious Red became one of the strongest players, and supported the new ideas with all the strength of his virile personality. The shop pulse now began to show decided improvement. The men walked with a snappier step, they swung their hammers with new spirit, and the general atmosphere of the shops was surcharged with vigorous vitality and cheerfulness. Engines began to leave the shops ahead of their schedule time, and the graph chart showed the month's work finished three days ahead of time. The conference committee recommended an increased allotment for the next month, and the end of that month showed the graph with a perfect record. Not once did the men allow their progress line to go under that forbidding line. Their fighting pride would not allow it.

The next feature to be introduced to the shop, was a shop news board, where the most interesting items of the daily shop mail were posted each morning. Hitherto the men had to depend on the "stove pipe" committee for their shop news. Now they were given this news in a brief authentic way and the eagerness with which they read these items was ample proof that they had been starving for mental shop food. The daily serving of this mental food satisfied this hunger and developed an interest in the work of the entire shop that was marvelous.

The increased production of the big shop was of course noticed by the general superintendent of motive power and he wrote Jack a letter of congratulation. Jack was too big a man to accept the entire credit and wrote to the general superintendent asking that he include the entire forces of the shop in his congratulations. This spirit pleased the general superintendent, and his next letter was stronger than the first, and included the entire personnel. Jack personally placed that letter on the shop news board, and felt that it represented the beginning of a better understanding between the management and the men.

Several days later the general superintendent visited the big shops and noticed the general air of good feeling which abounded. As they walked through one of the engine houses, a shrill boyish voice called "Hey Jack, how's your golf?" Turning quickly, Jack noticed a grinning grimy face peering over the top of one of the pits. The voice had a familiar sound, but the grime was so thick that he failed to recognize the face, so he walked over to the pit and peered down into the smiling eyes of a youngster who had been his caddy at the golf club. Jack's hobby was golf, and a warm friendship had developed between him and the boy. The cordial friendly greeting of the boy warmed Jack's heart and brought a big smile to the serious face of the general superintendent. Asking the boy a few friendly questions, they passed on.

Returning to the office of the general superintendent asked Jack to tell him the entire story of the new spirit in the shops and Jack gladly complied. The general superintendent was deeply interested and asked Jack's aid in developing the new spirit at all the shops. This Jack readily agreed to.

Months of patient work brought the same good results at the other shops, for the men were of the same mould and needed the same humane treatment and mental medicine to restore their interest and vigor. The new spirit spread throughout the railroad and Jack felt great satisfaction when the general manager recognized it as the main factor in the greatly increased efficiency.

The men had found that true happiness could be found in their work if they played square and they could trust the management to play square with them.

Present Cost of Rolling Stock in France.—A French paper called the "Journee Industrielle" has recently made a study of the present cost prices of rolling stock in France. The results of this investigation show that it costs from $4,050 to $5,400 for a box car, $3,375 to $4,725 for a gondola car, and $2,025 to $2,700 for a flat car. The cost price of a modern passenger car, equipped with the latest improvements, is about $67,500 for a first-class, $43,875 for a second-class and $33,750 for a third-class carriage. The prices noted are given at present rates of exchange.

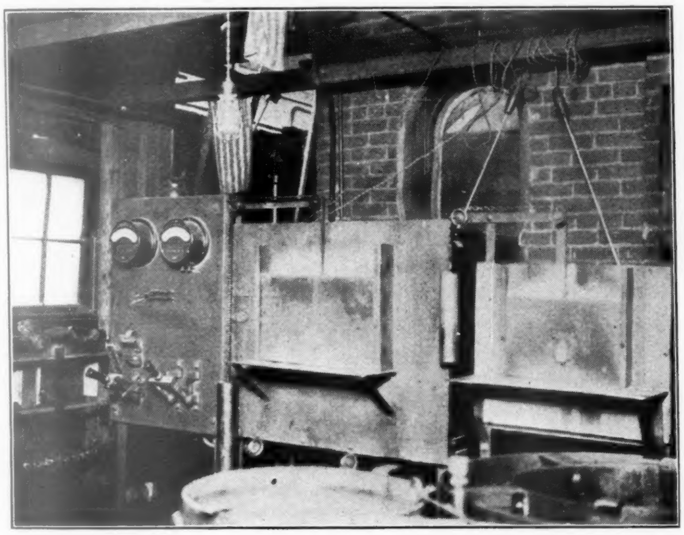
A Modern Tool Room Heat Treating Plant

Electric Furnaces and Pyrometers Installed at Ft. Wayne Shops of the Pennsylvania System

ACCURATE temperature control in heat treatment is one of the most important considerations in insuring good tool service. This is a fact which is coming to be generally recognized in railroad shops, and the use of special equipment has for several years been replacing the old hand forge method of hardening and drawing these tools.

A new heat treating plant has recently been installed in the tool room at the Ft. Wayne, Ind., shop of the Pennsylvania System in which complete provision has been made to insure uniformity of results with the expenditure of a minimum amount of labor. The plant is adequately equipped for handling all classes of tool work and is of particular interest from the fact that electric furnaces and pyrometers are used for the hardening operations.

The plant is called on to handle a wide variety of work, some of it in considerable quantities. The largest output is beading tools and flue expanders. About 300 beading tools are treated a week, for use at Ft. Wayne and a number of other points on the system. The output of flue expanders is considerably less, but in putting them through the plant they are handled in lots of about 200 at a time. The remainder of the output is made up of special tools of various kinds, such as taps, reamers, special milling cutters, inserted cutter blades, shear blades and punch and die work. Several examples of the variety of special tools turned out are shown in one of the photographs. In the manufacture of many of these tools, axle steel, case hardened, has been used.



Electric Furnaces and Switchboard at the Ft. Wayne Heat Treating Plant

The Electric Furnaces and Equipment

All hardening and annealing operations are carried out in two electric furnaces. These furnaces are of different types and provide different temperature ranges. The two are used together on hardening operations. The low temperature furnace, shown at the right in the illustration, has a maximum temperature limit of about 2,000 deg. F. and is used for annealing and hardening carbon steel tools, heating case-hardened carbon steel tools for quenching and pre-heating tool steel to a temperature of about 1,800 deg. F. The high temperature furnace has a maximum temperature limit of 2,500 deg. F. In this furnace the pre-heated tool steel pieces are finished to the proper hardening temperature, ranging from 2,250 deg. to 2,300 deg. F.

Both furnaces are of the muffle type but differ materially in the type of heating elements used. The elements in the smaller furnace are of the so-called hairpin type. Surrounding the refractory muffle are four slabs of refractory material provided with longitudinal slots in which fit the hairpin heating elements. These elements are inserted by removing the furnace front, which exposes their closed ends, and are placed entirely around the top, sides and bottom of the muffle lining. At the rear of the furnace, the ends of adjacent elements are joined by a series of connector blocks, with the exception of one pair to which the lead terminals are attached. This furnace operates on a maximum of 55 volts which is obtained by means of a regulating transformer. The secondary winding is divided into sections, each of which corresponds to a different voltage and the terminals of these sections are connected to a bank of single knife switches by means of which any section, or combination of sections, may be connected to the heating elements of the furnace. There are five of these sections, which afford a wide range of voltage and temperature regulation.

This furnace has a heating chamber 26 in. long by 8 in. high by 12 in. wide and has a full load rating of about 15 kilowatts. At full load about one hour and thirty minutes is required to bring the furnace up to its maximum temperature limit of 2,000 deg., after which this temperature may be maintained on about two-thirds of the full load rating.

The high temperature furnace has a heating chamber 18 in. long, 8 in. high and 12 in. wide. In this furnace the heating elements are carbon plate resistance piles which are placed inside the muffle on both sides. These plates are about 1/4-in. thick and rest on heavy graphite blocks at the bottom. At the top the two piles are connected by a set of heavy transverse carbon plates. Graphite electrodes extend vertically through the bottom of the furnace and bear against the bottom of the graphite blocks, one on either side of the furnace. Hand wheels located conveniently in front of the furnace, through beveled gears, operate elevating screws which in turn bear against the lower terminals of the electrodes. The current thus passes from one electrode up through the carbon resistance pile on one side of the furnace, across the top to the carbon slabs, down through the carbon resistance pile on the other side of the furnace and out through the other electrode. Temperature control is obtained by varying the upward pressure against the carbon piles and hence varying the resistance.

Like the lower temperature furnace, current is obtained from the secondary of an air-cooler transformer which is wound in one section. The maximum voltage for this furnace is kept down to about 30.

This furnace has a full load rating of 30 kilowatts, at which about one hour and thirty minutes is required to bring it up to its maximum working temperature. Considerably less power is required to maintain a uniform working temperature after the furnace has become thoroughly heated.

The switchboard, shown at the left in the illustration of the furnaces, contains a switch, circuit breaker and an ammeter in the primary circuit of the high temperature furnace transformer. The pyrometer is connected to a double-throw switch by means of which it may be connected to the thermo-

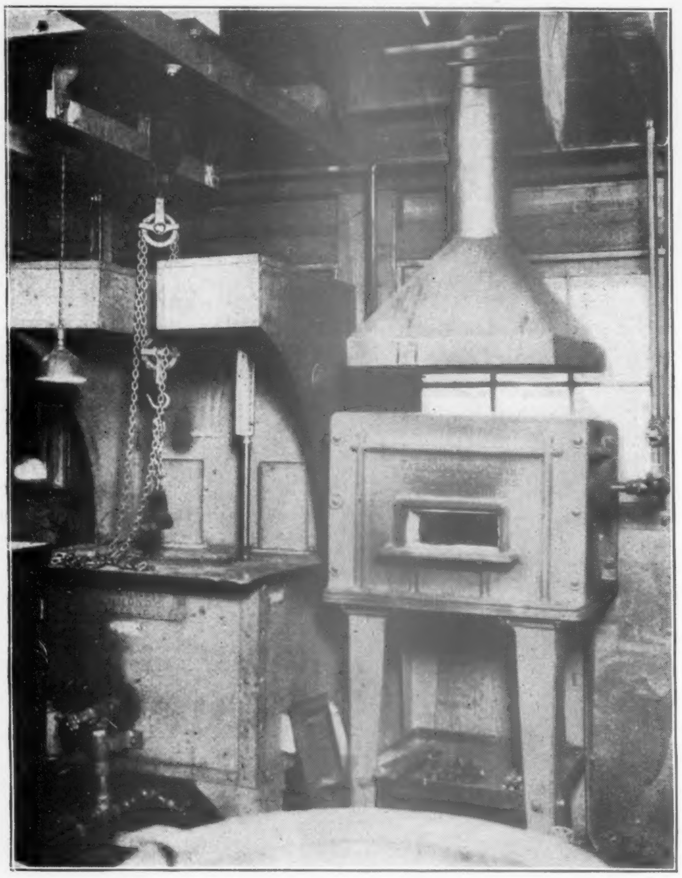
couple in either of the two furnaces. The switchboard for the low temperature furnace is attached to the side of the furnace frame.

Other Equipment

For low temperature drawing work an oil burning furnace of the oil bath type has been installed. Above this furnace has been placed a short monorail from which is suspended a chain hoist for handling the basket container into and out of the oil bath. As will be seen in the illustration, the temperature of the oil bath is indicated on a thermometer which forms part of the equipment.

A small oil burning muffle furnace has been installed to take care of various odd jobs for which the other equipment is not adapted. This furnace is useful for small forging jobs which it is desired to perform in the tool room and it is also used for short heats in hardening lathe centers and other pieces which it is not desired to heat all over.

The equipment of the plant also includes three quenching tanks containing water, salt water and oil, respectively. The oil and salt water tanks are jacketed and cooled with flowing water. These tanks are conveniently located to the electric furnaces. In hardening carbon steel tools they are first quenched in water till the vibration ceases and are then transferred to the oil. High speed steel tools are quenched in oil.



The Oil Bath Tempering Furnace and Small Oil Burning Muffle Furnace

Classes of Work Handled

When a run of high speed steel tools is to be treated both electric furnaces are used. This reduces the time required for the complete heating operation to that required to preheat the tools to about 1,800 deg. in the low temperature furnace. Work of this kind is handled in lots in order that as long a run as possible may be obtained without the necessity of cooling down and reheating the furnaces.

When annealing is to be done, the parts to be annealed are placed in the furnace at the end of the day's work, brought to the required temperature and allowed to cool down in the furnace during the night. This work is thus a by-product of the regular operation of the plant and costs practically nothing for power or labor.

Reference has already been made to the variety of special tools which are handled in the heat treating plant and to the fact that some of these tools are made from axle steel and case-hardened. The use of this material offers a number of advantages where occasional jobs come into the shop requiring special tool equipment and also for tools which are regularly but infrequently used. This material is not used for cutting tools which are expected to operate at high speed.

A Number of Special Tools Representative of Work Turned Out of the Heat Treating Plant

In the illustration showing a number of these special tools, the first one at the right is a hob which was made for use in replacing a broken worm gear from a coaling station on the line. This cutter was machined out of axle steel, sent to the blacksmith shop for case-hardening and reheated in the tool room for quenching. By its use the new gear was cut and the plant returned to service with only a few day's delay at an expense from which the cost of tool material was practically eliminated. Such tools manufactured from tool steel are difficult to harden without serious risk of fracture and loss both of the material and time expended in their manufacture. The case-hardening process is comparatively easy to handle and where the quenching heat is under control, as it is in the heat treating plant, perfect results are assured. Other tools of the same material shown in the photograph are a large 45 deg. reamer, a special reamer for finishing the piston rod pits of crossheads and a large special tap.

Among the other tools which have been developed and manufactured in the tool room are shown two sets of punches and dies for cutting piston rod and valve stem swab rings and a special three-fluted cutter for machining the crosshead key slots in piston rods. This work is done by first drilling a hole of the proper size at one end of the slot, setting the rod up on a milling machine table with the cutter inserted through the hole and finishing the slot with the cutter.

At the left in the illustration is shown a set of punches and dies for perforating driving box grease cellar plates. The punches are mounted in short sections of hardened steel which in turn are secured to a soft steel bar. The die blocks are also formed in short sections and similarly mounted on a bar of soft steel. The punch on which the work is done operates at the rate of 80 strokes per minute. Each stroke

perforates two rows of holes and the work is complete in 19 strokes at a total time of about a quarter of a minute per plate. The finished plate is clean and smooth with no distortion or fins at the edges of the holes whatever.

The equipment of the plant includes a Sclerscope, which instrument has proved of value in checking up the work of the plant and determining the temperatures to be used on various steels.

Results

The plant has justified expectations as to providing better and more uniform service from the tools turned out. Before this plant was installed, in making up a lot of flue expanders it was the regular practice to include a number of extra sections in each lot. These were always needed to replace sections broken in hardening. Since the electric furnaces have been in use, no breakages of this kind occur and the physical qualities of all of the hardened sections are exactly alike. When beading tools were hardened in the blacksmith shop they frequently broke in the shank, it being impossible to harden them all over alike. Now these tools are heated to a uniform quenching temperature all over and so far no trouble has been reported from failures in service. The same conditions apply with respect to special rivet sets and air hammer chisels. These tools are annealed, hardened and drawn at a uniform temperature all over.

Not the least of the benefits which have resulted from the operation of this plant is the saving in labor as compared with the old methods of heat treating tools in the blacksmith shop. To take care of this work it formerly required two men on blacksmith fires. Now, one man is easily able to take care of the work, which from the tool hardeners' standpoint is performed under conditions far less exacting. The operation and maintenance of the electric furnaces requires no knowledge of electricity, and skill in regulating furnace temperatures within narrow limits is readily acquired with a small amount of practice.

THE DRIFTING VALVE

BY S. H. LEWIS

When a locomotive drifts the fire box gases, at high temperature, smoke and the atmosphere are forced into the cylinders and destroy the oil which is supplied for lubricating them. These elements leave abrasive deposits and cause the cylinder packing to break or wear out in a small percentage of the time that it would otherwise be useful. This in turn decreases the power of the locomotive and in point of economy and service the exclusion of the gases, smoke and atmosphere is desirable and important.

To prevent the creation of vacuum within the cylinders, numerous valves have been invented for supplying steam to the cylinders while the locomotive is drifting, and the best known of these may be considered as being of three types, viz., hand-operated, semi-automatic and automatic.

Owing to human fallibility the hand-operated valves are unreliable and dangerous. As they are not opened regularly they do not prevent the creation of vacuum at all times when the locomotive is moving and damage results. As they are not closed with regularity they have caused locomotives to move or slip when unattended, and have increased the liability of personal injury and damage to property.

The semi-automatic valve employs a pressure operated valve in conjunction with a hand operated control valve which is supposed to be opened at the beginning of a trip and closed at the end of the trip. This type is open to the same criticism as the hand operated type with respect to human fallibility.

The automatic valve is either pressure operated or mechanically operated and will give the desired results only where such valves prevent the pressure within the cylinders from falling below atmospheric pressure *at all times* when the locomotive is moving.

From the foregoing it may be reasonably concluded that a drifting valve should be automatic, and as expense is increased and service impaired by the creation of vacuum in locomotive cylinders, it is obvious that a drifting valve should not depend for its operation upon vacuum created in the cylinders. It is equally true that a drifting valve should not depend for its operation upon compression created in the cylinders as compression and vacuum occur simultaneously in opposite ends of the cylinders.

Classification of Drifting Valves

The steam supply pipe should be arranged to prevent condensation and the delivery pipe from the drifting valve may be so arranged that *superheated* steam may be supplied to the cylinders through the valve chests and steam distribution valves or *saturated* steam may be supplied through the same channel, or *saturated* steam may be supplied direct to opposite ends of the cylinders. These methods are subsequently referred to respectively as arrangement *A*, arrangement *B*, and arrangement *C*.

In arrangement *A*, the steam is delivered to the *saturated* steam compartment of the superheater header or the dry pipe, and passes through the superheater units before reaching the steam chests and cylinders; in arrangement *B*, the steam is delivered to the *superheated* steam compartment of the header or piped direct to the steam pipes or steam chests, and in arrangement *C*, the steam is delivered to the cylinder clearance spaces through non-return check valves. The check valves serve to prevent the passage of steam from one end of the cylinder to the other when the throttle is open.

With arrangement *A*, the drifting valve may remain open at the time that the locomotive is moving as the steam from the drifting valve passes through the superheater units when the throttle is open and when the locomotive drifts.

With arrangements *B* and *C* it is necessary, in addition to the drifting valve closing automatically with the stopping of the locomotive, that it close automatically with the opening of the throttle when the locomotive is moving in order to prevent delivering saturated steam to the cylinders with the *superheated* steam when the throttle is open. It is also necessary for the prevention of vacuum, for the drifting valve in the arrangements *B* and *C* to open automatically with the closing of the throttle and in time to maintain steam within the cylinders until the locomotive stops or the throttle is again opened.

The volume of steam necessary to prevent the creation of vacuum in the cylinders varies according to the diameter of the cylinders, the speed of the locomotive and the position of the reverse lever or point of steam cut-off, and will require approximately the use of a 1¼-in. pipe for 22-in. and smaller engines, a 1½-in. pipe for 23-in to 26-in. engines, and a 2-in. pipe for 27-in. to 30-in. engines.

Advantages of Drifting Valves

It has long been recognized that manifold advantages, including the prevention of vacuum, are derived from the presence of steam in suitable quantity in the cylinders of a locomotive at all times when the locomotive is running above a very low speed, and that these advantages can be fully derived only through means to supply and cut off the steam automatically. A drifting valve which functions properly distributes and preserves the valve and cylinder oil, provides a steam cushion for the machinery, prolongs the life of the cylinders, pistons and rod and cylinder packings, protects the superheater units and prevents the loss of high cylinder temperature when drifting and results in increased locomotive mileage, decreased maintenance cost, higher average power, and increased mileage per unit of lubricant.

Looking Up the Machine Side of the Boiler Shop, Canadian Pacific Angus Shops, Montreal

Taking up the Slack in Production

How Causes of Lost Time on Unit Operations are Located and Removed at the C.P.R. Angus Shops

BY E. T. SPIDY
Production Engineer, Canadian Pacific, Montreal, Que.

THE functions of production may be divided into two classes: first, those which devolve upon the management, and second, those for which the workman is responsible.

In the first class are the duties of the supervisory staff to handle all orders, get the proper material to the workmen, plan the work in order that the desired output is obtained, provide the workmen with proper tools, keep the machinery in order, see that each operation is performed at the right machine, provide suitable workmen for each machine, and so on. These functions are performed by the foremen alone in small shops, or by an increasing number of specialist supervisors, each attending to one function only, in large organizations.

The rate at which the actual work is done by the workman depends entirely on the skill and knowledge of the individual only when the functions of the supervising organization have all been performed properly.

The question is, how do we know whether all these functions are being performed properly? Do we know what output we are getting from each workman compared with what he should produce? What is the reason for the failure to get full output from each man? What action is taken when we do know the reason for these failures? No one will say that these are not vital questions, yet, how many railroad shops have any definite system by means of which they can determine the answers with any degree of accuracy?

These are days when material is hard to get. Conditions are different from any previously experienced and good men are exceedingly scarce. Wages are so high that our old conceptions of what a job should cost are worthless. It is obviously our duty, not only to the railroads but also to ourselves as citizens who realize that idleness expense—which is what inefficiency really means—can only add to the growing cost of living, to reduce this idleness expense by first finding out where it is and then applying the best available remedy. If we know where it is something can be done.

The methods of accurately determining the answers to the above questions which are described below are not new. They have been developed by a number of industrial engineers and applied in various ways to meet varying local conditions. In some shops the production department looks after them, in others the foreman himself has a man detailed for the work and supervises it personally. The process of checking up the details of production in a few departments will clearly develop the system.

It may be assumed that something appears to be wrong with milling machine production. A man who has the status of an assistant foreman is sent to that department with instructions to keep an accurate record of all the work being done by these machines. He records the time when each job starts and when it finishes. He is on the spot constantly and notes every time the workman is delayed. He is looking for the delays, and as soon as one occurs he notifies the shop foreman, the tool foreman if it is a tool failure, or whoever should apply a remedy. The record of these delays and the amount of time lost is retained for the purpose of compiling the summary records described later. As each job is started he ascertains the time it should take and notes this for comparison with the actual time taken. The time which should be required may be taken from piecework schedules which most shops have, even though not in use, or when no records are available, it may be estimated on the floor.

As soon as the time on a job has exceeded what we may call the allowed time for that job, lost output is obvious and the observer must account for the discrepancy, showing the reason on his record. He then notifies the foreman or supervisor responsible for correcting the faulty conditions as soon

as possible, and takes such action himself as is within his power.

Each day's performance is summarized on the special form shown in Fig. 1. Each sheet lasts for one week, and usually a record is kept continuously for two weeks in the one department, by which time usually the habitual delays of the department are fully apparent. In addition to those for which remedies may be applied immediately, there are often conditions requiring a change in policy which take some time to put into effect. These are discussed by the supervisors concerned, and the necessary consent having been obtained from the higher officers, are put into effect as soon as possible. Later on an-

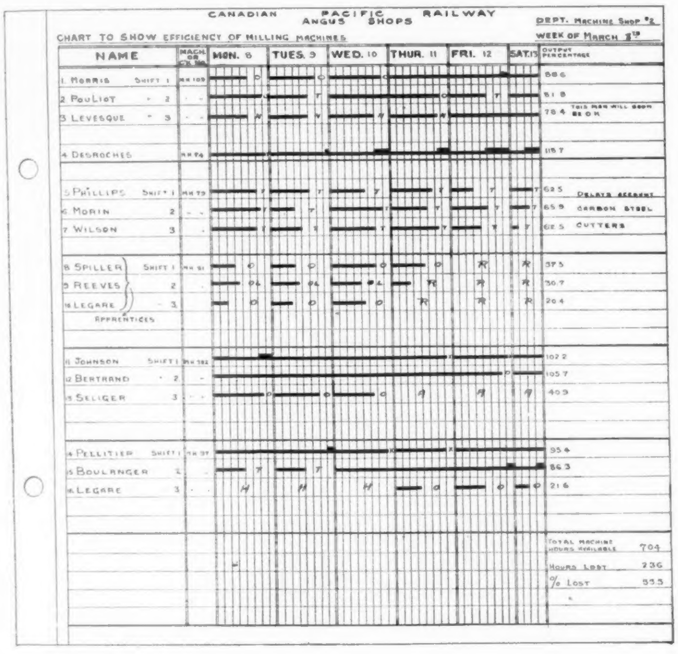


Fig. 1.—Chart Showing Results of a Detail Study of Milling Machine Operation

other department check is made to determine whether the improvements have had the desired effect and whether there are any further controllable delays.

The heading of the form states its purpose. A column is provided for each day of the week, and each day is subdivided into hours to facilitate entries. Each day's record is distinct and not combined with the next day in any way. When work runs into the next day, as it often does, the entry is not made until the job is completed, and then the percentage efficiency is prorated for each day. Horizontally, 100 per cent output is represented by the distance between the day columns, which on the actual form is one inch. If the operator gives only six hours' output in eight hours a thick black line is drawn in the space for the day equal to 6/8 of its width. The remaining space represents lost output and in it is placed a symbol letter or sign indicating the reason for the loss.

For convenience and uniformity a standard set of symbols is used which covers all delays in a general way. These are supplemented when necessary in certain departments to show special conditions. They are as follows:

A—*Man Absent.*—Used when there is available work, and a workman assigned to the job who is absent for any reason. This calls for the foreman to investigate causes and to discipline the absentee when necessary.

H—*Lack of Help.*—Used when there is work at the machine and no men available. More men are usually required if this appears frequently.

N—*New Man.*—Used to denote that the delay is caused by a new workman who is not yet familiar with the work. Such a man is expected to make good in a short time. This may call for instruction by the foreman.

O—*Up to the Man.*—Used when there is reason to believe that all conditions are favorable and the workman could himself prevent the lost time. Consistent delays on this account indicate that the man should be replaced.

X—*Reason Not Clear.*—Used when it is believed that the man is not to blame and conditions are good.

D—*Defective Work.*—Sometimes a defective piece of work requires special care that makes a delay. This account is up to the shop foreman to regulate.

M—*Defective Material.*—Used when the delay is creditable to defects in the material itself. Troubles from this source are referred to the test department or to the purchasing department.

W—*No Work.*—If no job is available when a man finishes the job in hand, the time lost in hunting up the foreman to get one is charged here. The extent of losses on this account are an indication of poor management in most cases, although it may be due to lack of orders, in which case the man must be disposed of on other work or laid off.

L—*Lack of Instructions.*—Used when delays occur due to lack of information or instructions of any kind, such as no drawings or sizes, which any supervisor has to supply.

P—*Power House.*—If compressed air, steam, water or any other power supply goes off it is recorded under this heading. This item is usually up to the power house engineer.

R—*Repairs.*—Used when the machine is placed under repairs, because of breakdown, changes or any other reason, when there is work available. The shop engineer is usually responsible for keeping this item down.

T—*Tool trouble.*—Failure to deliver output on account of defects, repairs to, or breakage of tools is up to the tool shop foreman to correct. Lack of a proper supply of tools and delays in getting them are also included in this account.

V—*Shop Closed*—Used when vacations or any other shut downs occur, during which no output is expected.

Some delays cannot be overcome, but it is seldom that something cannot be done to prevent them from becoming of regular occurrence. Delays may often necessitate several supervisors getting together before a remody is decided on, which always results in some future improvement being effected.

Referring to Fig. 1, it will be noted that the first man, Morris, turned out 60 per cent of a day's work on Monday, 70 per cent on Tuesday and better still each day; it was proved that there was no trouble for which he himself was not responsible. This is a common experience under this system. The second man, Poullet, was evidently an experienced operator, but had tool trouble on Tuesday. This proved to be accidental. The third man, Levesque, was a new man and unfamiliarity with the machine was responsible for his delays. These three men all operate the same machine on different shifts.

Deroches, the fourth man, is an efficient operator. Practically every day he turned out more than the allotted day's work, as indicated by the extra line. This, in a piecework shop, represents earnings over his wages.

The next three men each failed to give a day's work on account of tool trouble. This trouble was so apparent and consistent that it led to an investigation which showed the necessity of making a change in policy. It was found that owing to war exigencies this machine was equipped with carbon steel cutters. It was proved conclusively that high-speed cutters were required to reduce the expense of the work, and instructions were issued for this change to be made as soon as possible. Incidental to this, a change in design was found desirable. It was shown in experiments made later that by using a high-speed cutter of larger diameter and shorter length better time was made milling around links and such work singly instead of doing two at a time. Two pieces at a time produced too heavy a load for the machine.

Items 8, 9 and 10 show the performance of a machine run by apprentices. This was not very good, and on Thursday it will be seen that the machine broke down and one apprentice was transferred to the last machine on the sheet, where there was a vacancy on the third shift.

It will be obvious that a chart of this nature tells the whole story of shop output and troubles. The expense of getting it is negligible compared with the value of a knowledge of all the facts and the ability to place them before the right parties—the only way to ensure better results.

A summary of Fig. 1 shows that there were 704 machine hours available for production. Summarizing the delays, it will be seen that 236 machine hours have been lost for various reasons, a loss of 33.3 per cent for the week. These losses are chargeable as follows:

	Hours	Per Cent of available hours
R—Machinery repairs	49	7.0
T—Tool trouble	63	8.9
N—New Men	10	1.3
O—Lack of skill	61	8.6
A—Men Absent	20	2.8
H—Lack of help	24	3.4
X—Reason not clear	3	.4
L—Instructions	6	.9

By presenting the responsible supervisors concerned with data of this nature they all realize that a measure of their efficiency is in the hands of the management, on which fair judgments can be based.

The reason for the delays is always insisted on, and shifting responsibility is of no use because the other man will refuse to accept what is not his due. On the workman's part he realizes that a continued bad showing surely will result in his transfer to inferior work, or worse.

Fig. 2 shows another of these forms on which is recorded a specific condition. Having a large amount of boiler work on hand and not being satisfied with the output, it was determined to learn the reason for what was considered an excessive amount of time required for each engine.

The department, it will be noted, is operating two shifts,

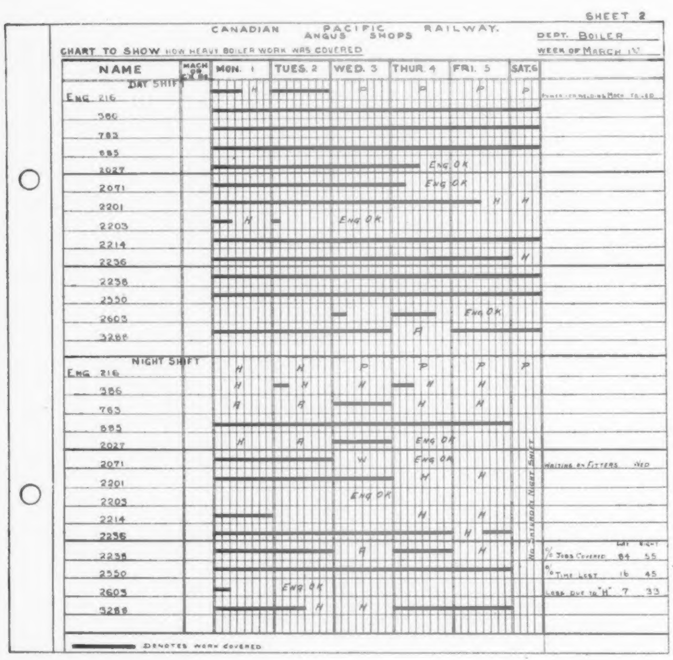


Fig. 2.—Chart Showing the Effect of Insufficient Help on Heavy Boiler Work

and the top half of the chart is devoted to the day gang, while the lower half covers the same engines on the night gang. On this chart is being checked how the work is covered by the workmen, to determine the reason why no workmen are on a job when the work is available. In this case spaces representing time with no boiler work scheduled are left blank.

This chart shows very plainly that the boiler shop foreman is confronted with more work than he has men to cover. It shows also that he has much trouble with absentees. The lack of uniformity of the lines on the chart shows that despite all planning to cover work, on account of the absentees and shortage of men he is switching his men from one place to another to make the best use of them.

A few other reasons for delays requiring investigation are to be seen on this chart. Delays marked *W* prove that the fitters are not through when the boilermakers arrive to make the test, which indicates the weak point.

The chart shown in Fig. 3 looks altogether different from the others, showing few delays and in general all operators making good. This indicates what a good chart should look like, although it might be still better. There are features which should be looked into, such as to be sure that the shop is not overstaffed with non-producers, but it reflects good management by its obvious lack of lost time. This shop is a manufacturing department and is not subject to such quick changes and short-time jobs as the others. It should not, of course, be judged on exactly the same terms.

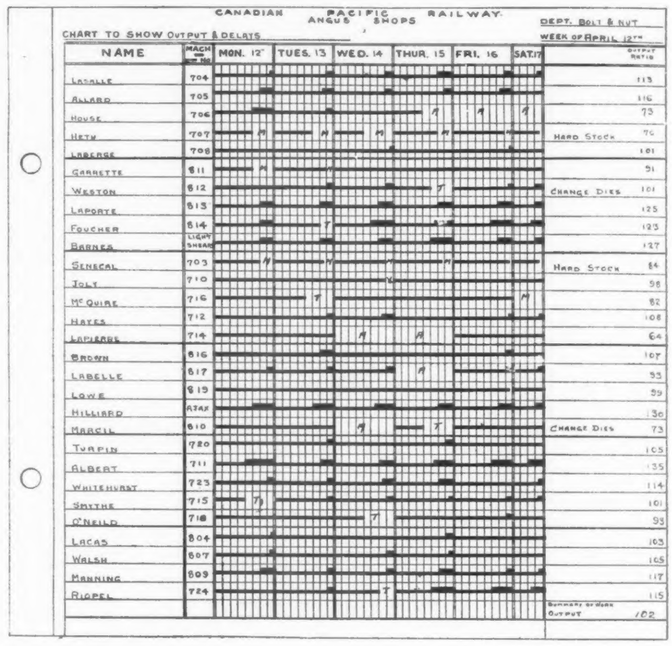


Fig. 3.—A Chart Taken in a Manufacturing Department

Fig. 4 shows a form on which the details are recorded by the checker. Each job is entered as it is started and is filled in as the work progresses. Delays are usually entered on the line below, with reasons in detail.

This system is independent of any other system in the shop, and it does not matter whether it is a daywork or piecework

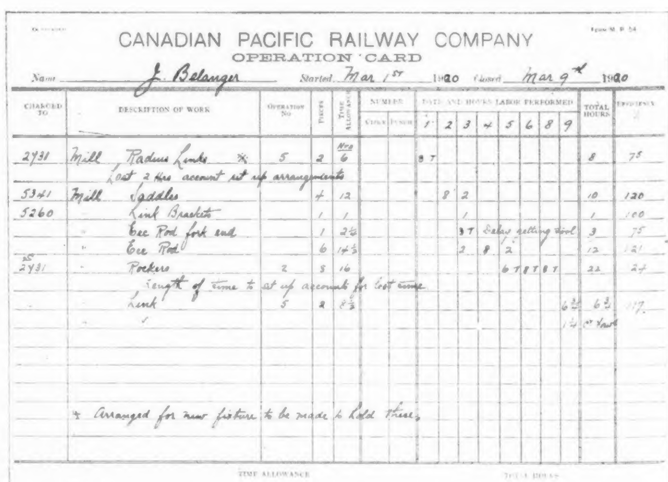


Fig. 4.—Form of Record Sheet Used in Making Detail Studies of Delays

shop. It has no connection with the shop schedule or routing system, although it shows up defects in them if work is delayed. It can be adapted to show special conditions, as pointed out in Fig. 2. By reducing lost time to a minimum a greater output may reasonably be expected, and such results have actually been obtained.

Air Consumption of Locomotive Auxiliaries*

Cost of Wasted Air Shown and Condemning Limits Proposed to Raise Standard of Maintenance

The subject of pneumatically operated auxiliary devices† on locomotives was assigned to a committee after the meeting of the Association at Cleveland, May, 1918. The committee presented a report of progress at the last meeting and was continued for the following purposes:

(1) To obtain more complete and representative data concerning the air consumption of locomotive auxiliary devices.
(2) To obtain data for comparing the performance of metallic versus non-metallic packing in reverse gears.
(3) To devise a satisfactory method for testing auxiliary devices on locomotives.
(4) To submit a suitable test code for testing auxiliary devices on locomotives.
(5) To suggest and recommend suitable limits for rates of air consumption of auxiliary devices to serve as a maintenance standard and to condemn defective devices out of service.

The larger portion of the data collected and analyzed by the committee were in connection with standing tests, i. e., tests made to determine the rate of air consumption of auxiliary devices with the locomotive standing in the roundhouse. A total of 497 such tests were made on as many devices. These tests involved 111 locomotives as found on 12 railroad systems. It was necessary in every case to convert the results obtained on the test basis of 60 lb. air pressure to a basis of 100 lb., the nominal main reservoir pressure so widely used in freight service.

The first work done was to devise a method of test and prepare a suitable test code so that it would be possible to direct the making of the standing tests at different localities in a systematic and uniform manner. The test code was sent out to about 30 members, with a request that standing tests be made of all kinds of auxiliary devices in use. In every case where the recipients were able to comply with this request, a number of tests were made in strict accordance with the code, and no special difficulties were reported either in following out the method of making the tests or in computing the results.

With this code the committee sent out a tentative set of condemning limits which were arbitrarily chosen in an attempt to compromise between the degree of perfection possible to attain on the one hand and what might be regarded as excessive maintenance costs on the other hand. All the standing test data has been referred to these limits elsewhere in this report, and while this comparison shows that they would condemn a very large percentage of the devices tested, no change in the limit basis is thereby justified. It should be borne in mind that the devices tested were taken as found in service where no accurate or reliable provisions for their maintenance were in force. Under conditions of systematic maintenance much better results would be obtained and it is not improbable that the limits here suggested could be materially reduced before passing the point of diminishing returns on maintenance investment. This, of course, is a matter which will be dictated by future experience.

The Standing Tests

The only test apparatus necessary for making the leakage rate tests specified in the code is an orifice holder with suitable orifice discs, and a test gage.

The orifice holder may be a flat lipped union pipe fitting suitable for holding the orifice disc and the necessary pipe connection for attaching it to the drain cock or any other suitable connection to the main reservoir. The orifice disc at the orifice should be 1/16 in. thick and the hole should be accurately bored, (not drilled) with sharp edges. The rim of the discs may be somewhat thicker to give strength, but the thicker part should not come nearer at any point than 3/16 in. to the orifice itself. It is preferable to make the orifice out of hard brass, bronze or monel metal. The test gage should be installed so that it will indicate the main reservoir pressure. It is not absolutely necessary because the regular brake equipment gage in the locomotive cab can be used. Any inaccuracy in the gage employed is eliminated, provided the test comparison is always made at the same pressure. This is because the nature of the test is to compare the flow of air due to leakage with that through a known orifice.

TABLE I—FORM FOR THE TABULATION AND COMPUTATION OF TEST RESULTS

Loco. No.......... Class.......... Div........... Date..........

METHOD:	Compressor type and orifice diameter			
	Make and size of compressor	Dia. of orifice, in.	Air press., lb.	
Throttle compressor steam valve until 60 lb. air pressure is just maintained in main reservoir. Count compressor speed in single strokes per minute.	West., 9½ in.	11-64	60	(Orifices are the same as used for I. C. C. compressor condemning tests).
	West., 11 in.	3-16	60	
	West., 8½ in. C. C.	9-32	60	
	N. Y., 2-a	5-32	60	
	N. Y., 6-a	13-64	60	
	N. Y., 5-b	15-64	60	

	TESTS: Compr. speed single strokes per min.			COMPUTATION OF RESULTS: Compr. strokes per min. due to		
	Leakage only*	Lkg. plus orifice*	Lkg. plus device	Orifice only	Device only	Per cent of strokes. Col. 6, col. 5
1	2	3	4	5	6	7
Reverse gear, ¼ forward	......	......	......	......	......	......
Bell ringer, on	......	......	......	......	......	......
Ash pan Open	......	......	......	......	......	......
Ash pan Closed	......	......	......	......	......	......
Sander (per each 3-32-in. orifice)	......	......	......	......	......	......
Cylinder cocks Open	......	......	......	......	......	......
Cylinder cocks Closed	......	......	......	......	......	......
Water scoop Lowered	......	......	......	......	......	......
Water scoop Raised	......	......	......	......	......	......
Fire door Open	......	......	......	......	......	......
Fire door Closed	......	......	......	......	......	......
Coal pusher, on	......	......	......	......	......	......

NOTE:

(a) Where the locomotive is equipped with two compressors the counting of compressor strokes will be easier if one compressor is cut out.

(b) Where the leakage is so slight that it is difficult to accurately count the compressor strokes it is permissible to create a leak to increase compressor speed provided it is left unchanged during all three tests.

(c) Where the locomotive is equipped with an auxiliary device reservoir and governor it will be necessary to remove the auxiliary devices governor main valve while tests are being made.

*Cols. 2 and 3 give single observation for all tests as leakage and orifice are constant for all tests.

Col. 5 is the difference between cols. 3 and 2.
Col. 6 is the difference between cols. 4 and 2.
Col. 7 is col. 6 divided by col. 5.

The determination of the leakage rate for each auxiliary device tested will depend on the results of three tests. However, two of these tests will always be common to all devices tested on the same locomotive, so that after the first device is tested only one test will be required for each succeeding device tested on that locomotive. The methods of making the tests and the computation of results are briefly outlined in Table I, which shows a convenient form for recording the data.

In making the tests, close the compressor steam throttle valve, cut out the main reservoir supply to all air operated

*Abstract of a committee report and discussion, presented at the twenty-seventh annual convention of the Air Brake Association, held at Chicago, May 4-7, 1920.

†The term "air operated auxiliary devices" as used in this report refers to all air operated devices on locomotives which are not a part of the air brake system.

auxiliary devices, and see that the drain-cock at the orifice fitting is closed. Reduce main reservoir air pressure down to some value lower than 60 lb., preferably about 55 lb. Open the compressor throttle slowly until the compressor raises the main reservoir pressure and is just able to maintain it at 60 lb. When this condition has been reached for a time of about three minutes so that the tester can be sure that a true balance of the pressures has been obtained, the compressor speed in single strokes per minute will be counted. The count will be entered in column 2, under the heading "Leakage only."

The second test will be made in the same manner except that the drain cock leading to the orifice will be open. This will mean that in addition to the leakage, the compressor will have to maintain the main reservoir pressure at 60 lb. against the air passing to atmosphere through the orifice. Enter the compressor speed in column 3, which is headed "Leakage plus orifice."

The third test will be made in the same manner as the first and second tests except that the orifice fitting will be cut out and the particular auxiliary device to be tested will be cut in. The compressor speed will be entered in column 4, headed "Leakage plus device."

The computations are clearly indicated on the form and the final comparison for each device is expressed in per cent of strokes per minute required to supply the orifice.

Condemning Limits

It will be observed that the type of compressor with which the locomotive is equipped will determine the size of the orifice used. The orifice sizes chosen are the same as those specified by the well known Interstate Commerce Commission compressor condemning tests and can, therefore, be used for testing both compressors and auxiliary devices. These orifices and a suitable orifice fitting are always available at roundhouses and other places where the compressor tests are made.

TABLE II—LIMITS RECOMMENDED FOR CONDEMNING AIR OPERATED AUXILIARY DEVICES ON LOCOMOTIVES

Device	Percentage of orifice strokes allowed					
	9½ in. comp., 11/64 in. orifice	11-in. comp., 3/16-in. orifice.	8½-in. C. C. Comp., 9/32 in. orifice	2-a comp., 5/32-in. orifice	6-a comp., 13/64 in. orifice	5-b comp., 15/64-in. orifice
Reverse gear, ¼ forward...	31.2	26.6	11.6	38.2	22.6	17.0
Bell ringer, on............	9.3	8.0	3.5	11.4	6.8	5.1
Ash pan, open and closed..	46.8	40.0	17.4	57.2	33.8	25.4
Sander (per each 3/32-in. orifice)	31.2	26.6	11.6	38.2	22.6	17.0
Cylinder cocks open and closed	31.2	26.6	11.6	38.2	22.6	17.0
Water scoop, lowered and raised	62.5	53.3	23.2	76.3	45.1	34.0
Fire doors, open and closed.	15.6	13.3	5.8	19.1	11.3	8.5
Coal pusher, on...........	62.5	53 3	23.2	76.3	45.1	34.0

Table II gives the limiting values of percentages as computed in column 7 of the previous table. A value is given for each kind of auxiliary device when tested under the six different combinations of compressor and orifice size. Whenever the percentage of strokes found in column 7, Table I, exceeds the corresponding value given in Table II, the device in question should be condemned and ordered for necessary repairs.

TABLE III—AIR CONSUMPTION EQUIVALENT TO THE CONDEMNING LIMITS

Device	Leakage rate in cubic feet of free air per minute		
	At 60 lb. pressure	At 100 lb. pressure	At 140 lb. pressure
Bell ringers	3	4.6	6.2
Fire doors	5	7.7	10.3
Cylinder cocks	10	15.3	20.7
Reverse gears	10	15.3	20.7
Sander (per each 3/32-in. nozzle).......	10	15.3	20.7
Ash pan	15	23.0	31.0
Water scoops	20	30.7	41.3
Coal pushers	20	30.7	41.3

The leakage rates in cu. ft. of free air per minute equivalent to the condemning limits suggested above are shown in Table III.

The results of the standing test data are shown plotted in a convenient form in Fig. 1. The average maximum and minimum values for leakage are given for each condition under which the various devices were tested, and it is shown on the basis of 100 lb. main reservoir pressure. The corresponding test code leakage limit value is also shown for each device. The data shown are the most complete information of its kind in existence and can be regarded as a true index to the general condition and performance of auxiliary devices.

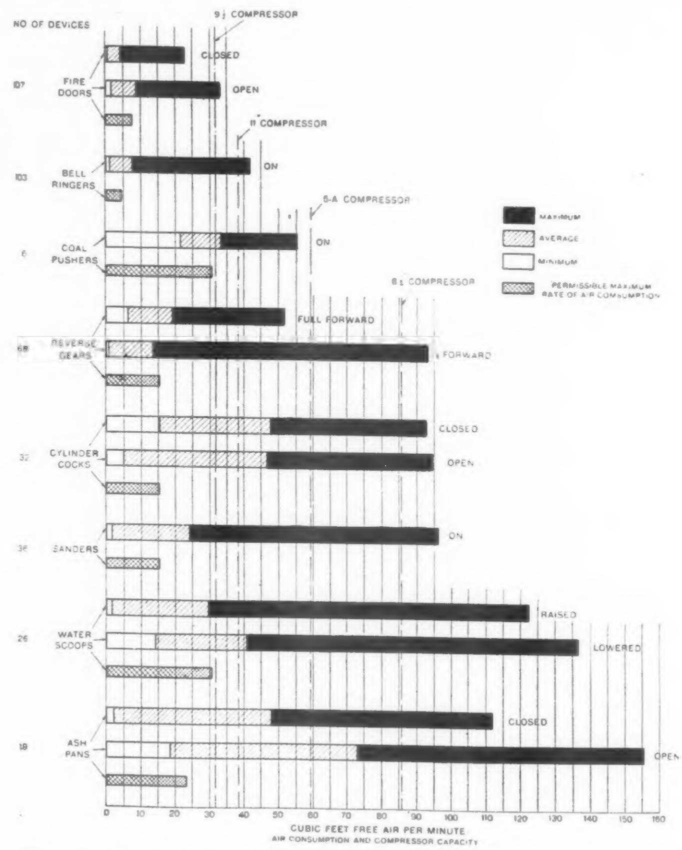


Fig. 1—Air Consumption of Auxiliary Devices of Locomotives Determined from Tests of 111 Engines

Table IV gives the result of applying the recommended condemning limits on all devices tested, more than half of which would thereby be condemned.

TABLE IV—EFFECT OF APPLYING CONDEMNING LIMITS TO THE DEVICES TESTED

Device	No. tested	No. passed	Per cent passed	Per cent failed
Reverse gears	68	47	69	31
Bell ringers	103	48	47	53
Ash pans	19	4	21	79
Sanders	136	46	33.8	66.2
Cylinder cocks	32	4	12.5	87.5
Water scoops	26	11	42	58
Fire doors	107	50	47	53
Coal pushers	6	3	50	50
Totals	497	213	42.9	57.1

Running Tests of Power Reverse Gears

To determine the air consumption rate for reverse gears when running in service, a very complete program of tests covering a period of about five weeks' work was outlined. It was impossible to carry out the program fully, but service runs were made with 21 locomotives which were distributed

on four divisions of three railroads. The data for these tests are shown in Table V.

The curves for three tests are plotted in Fig. 2. These curves represent respectively the worst gear tested, the best gear tested and the retest of the worst gear after it had been repaired to correct the leakage.

It will be noted that the tests included 15 gears having metallic packing and 6 gears with non-metallic packing. The tests were made without any special regard for either type of packing and show a distinct difference in the quality of service in favor of the metallic packing. This is evident from the average miles of service per cu. ft. of average leakage developed. The figures show that where the non-metallic packed gears made 249 miles for each cu. ft. per min. leakage developed the metallic packed gears made 2,491 miles, a ratio of just 10 to 1 in favor of metallic packing. The number of gears tested, however, is not sufficient to warrant final conclusions.

The Field for Profitable Maintenance

The general aspect of all the test results indicates that the air operated auxiliary devices are in a more or less uneconomical condition. They undoubtedly perform the intended functions in a very satisfactory manner, but only at the cost of compressed air. This cost is much greater than it need be, and the problem of reducing it to a minimum resolves itself into the determination of how much maintenance expense will be warranted. The test figures show a wide field for profitable investment in maintenance, and better maintenance will carry with it other betterments, such as less wear and tear, more perfect performance, and greater reliability, all of which will tend to turn to raise the efficiency of locomotive operation. The proposed condemning limits will serve to reduce the waste at least one-half, and when this saving is accomplished the association will be in a position to scale the limits downward on a scientific basis, because it will then have available actual maintenance cost figures.

The committee fully realized the importance of attacking this subject on a cost basis, but certain necessary service factors remain to be determined in a more accurate and reliable manner before such comparisons could be justified. A knowledge of maintenance costs would also be necessary to a complete analysis of the costs involved.

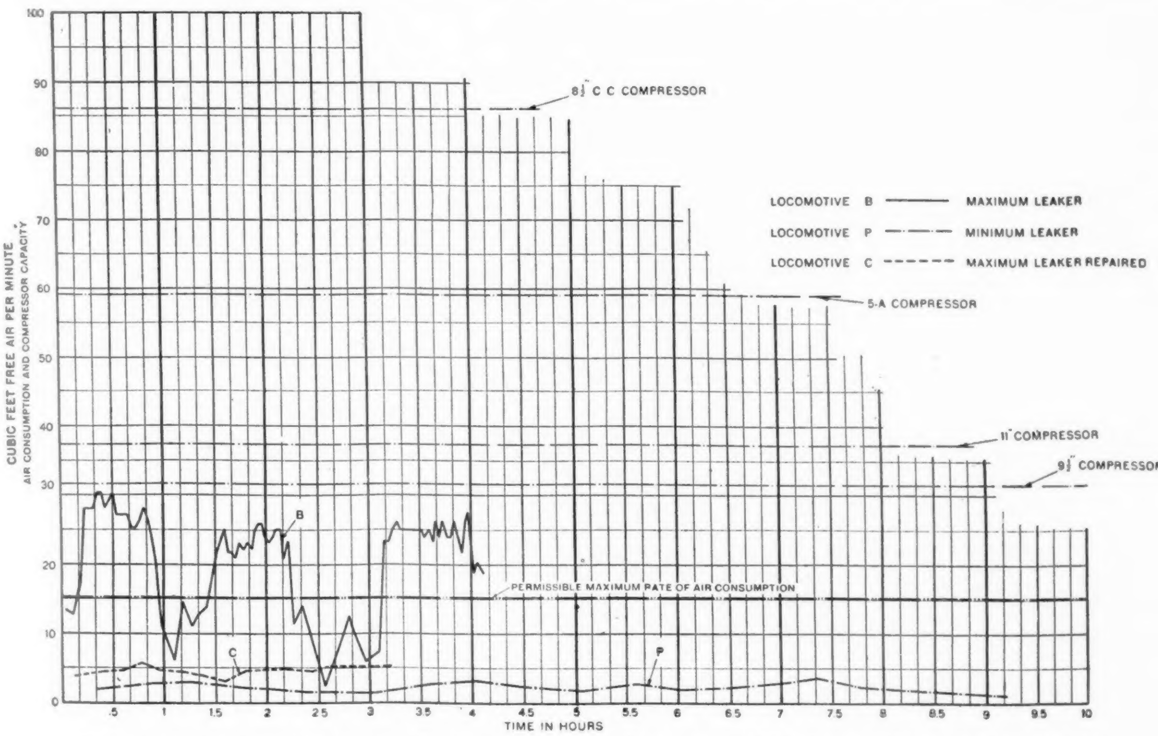


Fig. 2—Air Consumption Curves for Power Reverse Gears on Freight Locomotives in Road Service

TABLE V—SUMMARY OF REVERSE GEAR RUNNING TESTS

(Leakage based on 100 lb. main reservoir pressure.)

Locomotive	Type of ragonnet reverse gear	Kind of packing	Leakage, cu. ft. free air per min. Max.	Min.	Average	Total cu. ft. free air used during trip	Mileage from application of packing to date of test	Miles per cu. ft. per min. average leakage	Average
A	A	Non-metallic	29	4.9	13.8	6642	2,455	178.1	
B	"	"	30.5	2.2	22.1	5527.5	3,692	166.9	
C	"	"	5.9	3.2	4.7	927.9	1,002	215.4	249.2
D	"	"	4.9	3.1	3.9	696.5	2,500	628.8	
E	"	"	24.4	5.5	13.1	3519.4	2,356	179.5	
F	"	"	9.4	4.5	6.2	1081.2	784	126.6	
G	"	Metallic	13	4.3	7.7	2969.4	24,085	3139	
H	"	"	9.8	6	6.9	2305.3	26,058	3730	
I	"	"	60.9	4	17.5	7329	16,893	968.1	
J	"	"	24.4	12.2	20.9	5093.2	3,729	177.9	
K	"	"	9.6	2.1	6.7	2230.4	1,526	229.2	
L	"	"	4.9	3.9	4.4	1280.3	206	46.7	
M	B	"	26.1	5.1	18.7	3543.5	18,000	965.2	
N	"	"	23.2	4	12.8	3358.5	20,000	1566	2491.3
O	"	"	11.3	3.9	6.2	1225.3	18,000	2926	
P	"	"	3.6	1.4	2.3	1313	19,000	8422	
Q	"	"	62.6	5.8	13.8	2387	16,000	1156	
R	"	"	14.3	1.1	9.8	3047.4	29,564	3010	
S	"	"	21.5	2.8	17.1	3356.4	26,487	1548	
T	"	"	5.6	1.8	3.7	886.6	32,007	8594	
U	"	"	32.9	1.8	18.7	2776.8	16,678	891.3	

However, some of the facts demonstrated by the data have an important bearing on how much it is costing the railroads to operate auxiliary devices as compared to what it really ought to cost. In other words, it is possible to point out, on the basis of compressed air used, the probable margin of saving that could be effected by a reasonable maintenance program, from which it is comparatively easy to decide how much maintenance expense is warranted.

The data presented in Fig. 1 cover all the different kinds of devices tested. It is not permissible to base a comparison on all of the devices listed because several of them are not subject to constant use while the engine is in service. For the purpose of this comparison only three kinds of devices are chosen; namely, bell ringers, fire doors and reverse gears. It is assumed that the respective average rates of air consumption found for these three devices in the standing tests are characteristic of their average condition in service.

It can also be assumed that if these devices were maintained within the maximum rates of air consumption fixed by the test code limits the average leakage could be held to not more than one-half that represented by the limits. The actual figures for such a comparison are given in Table VI.

TABLE VI—ACTUAL AND POSSIBLE RATES OF AIR CONSUMPTION OF BELL RINGERS, FIRE DOORS AND REVERSE GEARS.

	Average-rate in cu. ft. per min. at 100 lb. main reservoir pressure. Actually found during tests	Insured by test code limits
103 Bell ringers	7.75	2.30
107 Fire doors	6.80	3.80
68 Reverse gears	16.57	7.60
Totals	31.12	13.70

It will be evident from the above table that locomotives equipped with the three devices listed would supply 31.12 cu. ft. of free air per minute to operate these devices, whereas if the devices were maintained within the test code limits the air requirement would only be 13.70 cu. ft. of free air per minute. This difference is decidedly impressive when

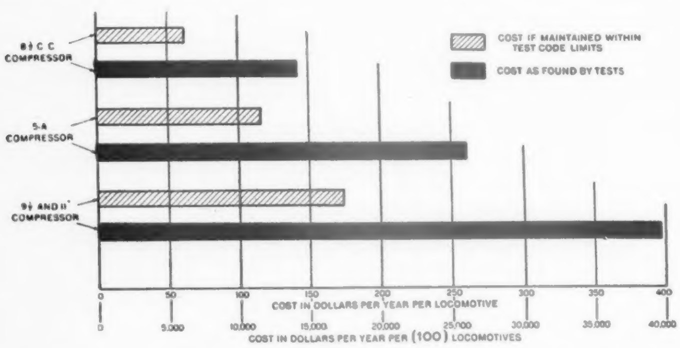


Fig. 3—Annual Cost of Compressed Air Used by Three Auxiliaries and the Portable Cost Under Proposed Condemning Limits

expressed in terms of the money value of compressed air. Such a comparison is shown in graphic form by Fig. 3. The cost values were computed from the data by using the following assumptions, which are commonly accepted as conservative for the factors involved:

1. That the average working time for locomotives is 6 hours per day or 2,190 hours per year.
2. That the average evaporation rate for locomotives will be seven pounds of water per pound of coal.
3. That the rate of steam consumption per 100 cu. ft. of free air compressed to 100 lb. pressure will be for the 9½-in. and 11-in. compressor, 68 lb.; for the 5-A compressor, 44.7 lb.; for the 8½-in. C. C. compressor, 24 lb.; based on actual steam consumption tests.
4. That the price of coal on the tender is $2.00 per ton.

The two extremes of the comparison in Fig. 3 can be pointed out as follows:

1. On basis of 100 locomotives having 8½ in. C. C. compressors, the cost per year without maintenance would be $14,000, and with maintenance, $6,170, leaving a margin of $7,830 for reduction of expense.

2. On basis of 100 locomotives having 11 in. compressors, the cost per year without maintenance would be $39,700, and with maintenance, $17,480, leaving a margin of $22,220 for reduction of expense.

The assumption of coal cost as $2 per ton on the tender is much too low to represent the actual average cost of coal. The reason this value was taken was to make it easy to convert the cost figures to correspond to any price paid for coal. It would not be unreasonable to contend that the average cost of coal on the tender is about $5 per ton, and in such event the costs and margin for economy would be two and one-half times greater than those given in Fig. 3. Likewise, it should be remembered that these figures are based on only three devices, all the others being ignored, although many locomotives have them. Those devices are, therefore, an additional source of compressed air waste, which was omitted in this comparison because no accurate data were available, and because its omission is in the direction of making the cost values more conservative. Other cost increasing factors, such as wear and tear on the compressor plant, cost of water, labor, etc., were also omitted, because exact data were lacking.

Discussion

It was very evident from the discussion of this report that few of the members of the Air Brake Association have realized the seriousness of the losses from air leakage in connection with the operation of auxiliary devices on locomotives as they are generally maintained. Some of the members, who had applied the tests recommended by the committee for the purpose of securing data to be used in the preparation of the report, testified as to their efficacy in bringing to light conditions causing excessive air consumption, which might otherwise continue indefinitely so long as the apparatus functions without positive failure. No objections were raised as to the practicability of the tests themselves, their simplicity and the ease with which inspectors may be trained to make them being commented on generally by those who have already tried them out. There was some difference of opinion, however, as to the proper time and intervals for their application. The committee offered no recommendation on this point, but left it to be worked out by the members as individual conditions and experience might dictate.

In discussing the cost of excessive leakage, the committee considered only those devices which are usually under constant pressure. It was brought out in the discussion that, while devices such as water scoops do not cause a serious waste of air in the aggregate because of their infrequent operation, they do draw heavily on the air supply when operating, and when neglected, excessive leakage may result in undesired applications of the brakes or inability to release the brakes, so that from this standpoint their maintenance is of equally as great importance as that of the more frequently operated devices.

The committee was continued to report at the next convention what progress has been made in establishing the tests and to what extent they have led to improved conditions. A suggestion was also offered to the executive committee that measures be taken to bring the paper to the attention of the American Railroad Association, Section III-Mechanical.

COOLING COMPOUNDS FOR CUTTER SHARPENING.—The cooling compound for wet grinding is a question on which there is considerable difference of opinion. Water is about as good a coolant as can be obtained, but it has the disadvantage of rusting the moving members of the machine. A cooling compound which has been used with good results is soda water. This comprises one pint of sal soda to 10 quarts of water. The solution is mixed cold and applied in the usual manner.—Grits and Grinds.

MACHINE TOOL

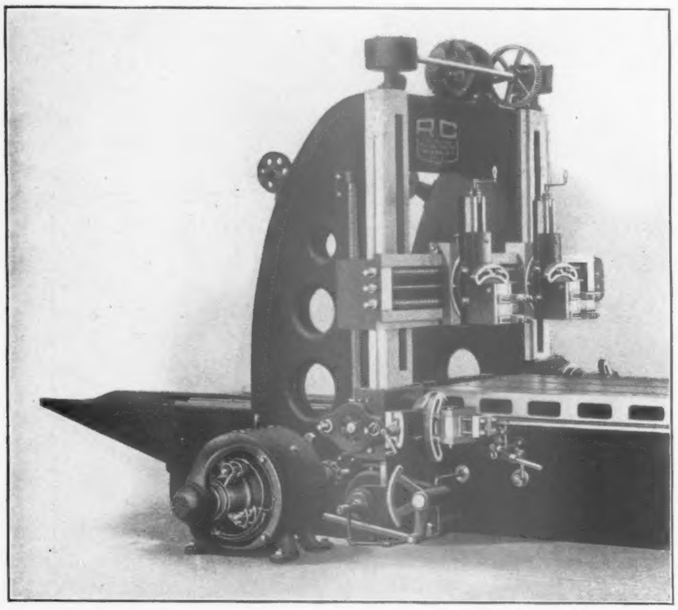
AND

SHOP EQUIPMENT

SECTION

High Power Multispeed Planing Machine

MECHANICAL engineers conversant with machine tool design recognize that the real problem to be solved in planer construction lies in overcoming the inertia of the high-speed parts, which may reach a value many times that of the massive table loaded with work. This inertia must naturally all be absorbed by the belts or motor at the moment of reversing. In the planing machine, illus-



View Showing Motor Drive Arrangement

trated, high-speed reversing parts have been entirely eliminated, thereby greatly reducing the wear and tear as well as the power required for reversing.

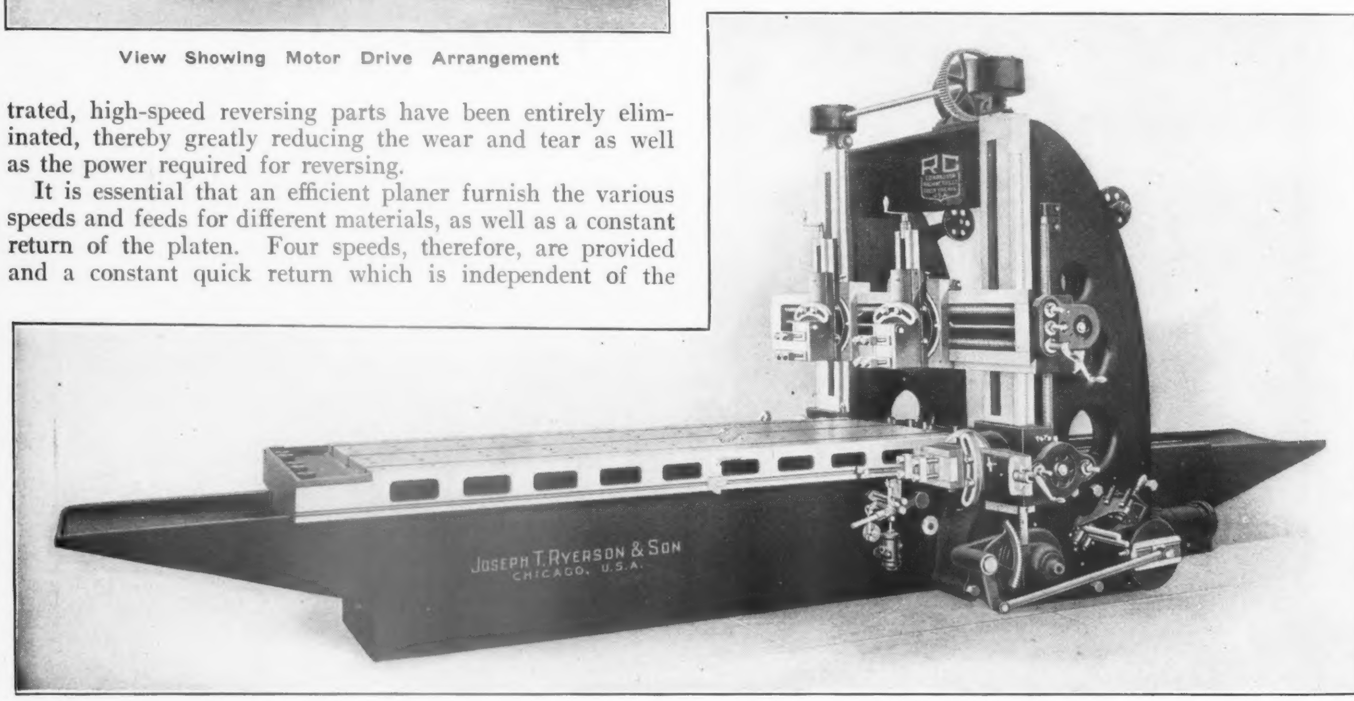
It is essential that an efficient planer furnish the various speeds and feeds for different materials, as well as a constant return of the platen. Four speeds, therefore, are provided and a constant quick return which is independent of the cutting speeds. For general machine shop work, cutting speeds of 25, 30, 37½ and 45 ft. per min. are provided in the heavier types, with a return speed of 100 ft. per min., all of which may be varied to suit requirements.

The motor is directly connected to the main drive shaft by a Clark flexible coupling. The primary shaft carries two-spool gears, and on the extreme end of this shaft the reversing pinion engages directly with the return clutch gear. The change gears are mounted on a square shaft and are shifted by a lever mounted in a gridiron. The pinion on this shaft meshes with the forward clutch gear, thereby giving four cutting speeds.

In order to provide a smooth, durable reversing mechanism, a special form of annular pneumatic clutch has been adopted, as this type is self-compensating for wear and requires practically no attention. Dogs on the platen trip the distributing valve, alternately admitting air to one or the other of the clutches. As a spacing rod connects the two, one is forced out when the air is admitted to the other, making it impossible to lock the drive gearing. The reversing of the clutch shaft is accomplished in this manner. The back gears, bull pinion, bull wheel, and rack are of herringbone design. This method of driving has been adopted, as it is difficult to build a machine with spur or spiral gearing that, for any length of time, will be free from showing a tooth mark. The chief advantages of herringbone rack and gear drive are continuous smooth operation, greater resistance to wear, reduction of back lash, and increased strength of the teeth. All gears and bearings are automatically oiled by the splash system, and the overflow of lubricant returns to a central tank by gravity.

The planer bed is of box section type, thoroughly reinforced. The wide supporting surface of each V is inclined 15 degrees to the horizontal, permitting the formation of a uniform oil film under the most severe conditions. The inner leg is inclined 15 degrees to the perpendicular, functioning as a guideway. The proportioning of the two is such that the wear is self-compensating. The pockets for lubricating the ways are automatically filled with the oil carried up by the bull wheel. Each end of the bed carries a large apron extending beyond the maximum travel of the table for catching all surplus oil which, after filtering, returns to the central tank by gravity.

The driving mechanism of the rack feed constitutes a departure from customary practice. A piston, operated pneumatically turns the feed regulating disk through 180 degrees, the crank of the disk being connected with levers to a gear segment, raising and lowering the feed rack. The moment



Ryerson-Conradson Planer With Pneumatic Feeds and Reversing Clutch

the table trips the air distributing valve, air is admitted alternately to one of the clutches as well as the corresponding end of the rack feed piston.

The cross rail elevating screws are driven by a motor mounted on a cross girth, the entire elevating mechanism consisting of spur reduction gears and a set of bevel gears, the latter placed directly on the elevating screw. The cross rail is of standard construction, permitting individual traverse and feed of each head in either direction. The heads on the cross rail and both side heads have power angular feed and are of extra heavy design. The side heads have power vertical traverse the full length of travel, and also power feed at any angle.

To operate the clutches and rack feed piston, compressed air is required, the pressure recommended being 80 to 100 lb. per sq. in. The air consumption of the planer is exceptionally low, ranging from 3 to 10 cu. ft. of free air per min. from the smallest to the largest size planer. For shops not having a compressed air system, suitable means are provided for connecting a small standard compressor directly to the main drive shaft.

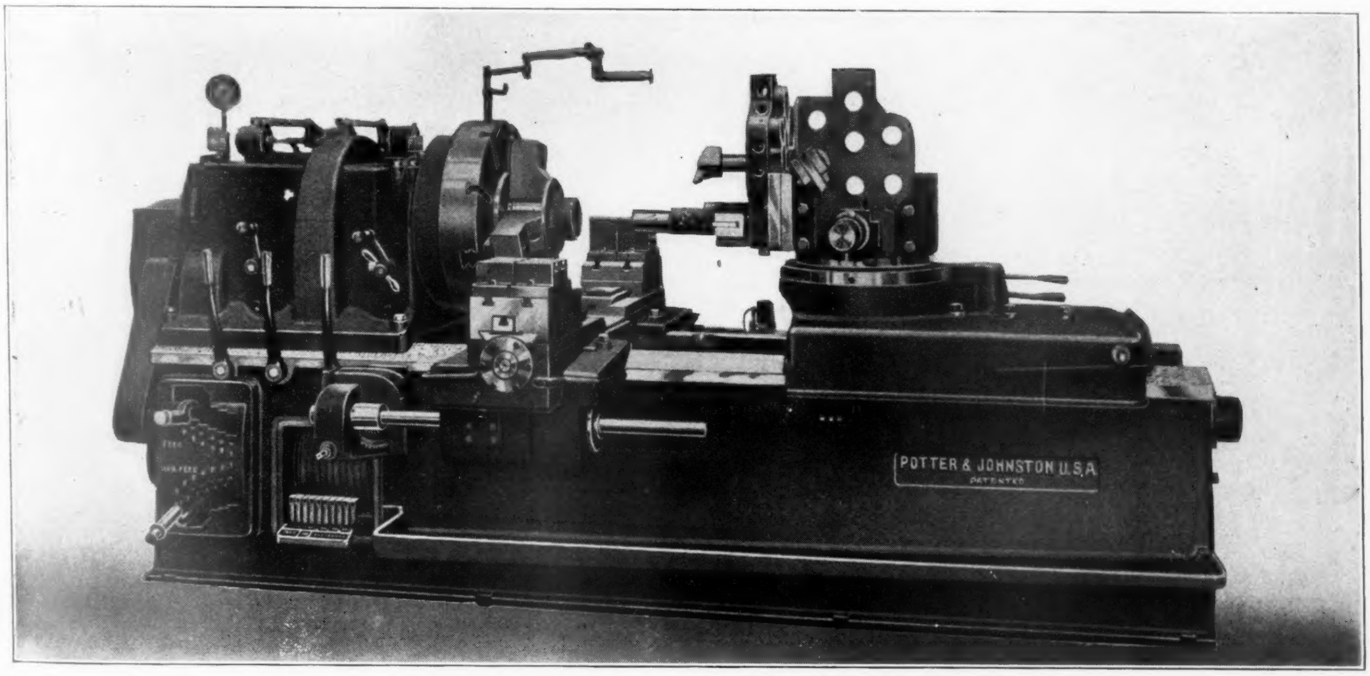
The planer described can be furnished in four sizes from 24 in. by 24 in. to 48 in. by 48 in. Driving motors varying from 3 hp. to 25 hp. are required, depending on the character of the work to be done. The machines have been placed on the market by Joseph T. Ryerson & Son, Chicago, Ill.

Automatic Chucking and Turning Machine

A NEW automatic chucking and turning machine, called the 8-B, has been developed by the Potter & Johnston Machine Company, Pawtucket, R. I. It is built with a geared automatic change speed head, and the spindle driving mechanism is all contained in the headstock, which is of unit construction. The machines are heavy, powerful and accurate, well suited to the manufacturing of multiple parts as in modern railway shops. The drive is by a single pulley transmitting 20 hp.

Four combinations of six automatic variations of speed are available, giving 24 spindle speeds in geometric progression from 6 r.p.m. to 92.5 r.p.m. Any one of these combinations may be instantly obtained by levers conveniently located on the headstock. The gearing for driving the spindle is self-contained within the headstock, all gears running in oil, which is pumped through all bearings. A gear on the spindle takes care of the higher spindle speeds, while the lower ones are taken care of by a gear fastened to the chuck or face plate.

The feed gearing is driven from the spindle. There are seven combinations of three automatic variations of feed, making a total of 21 feeds from .005 in. to .125 in. per revolution of the spindle. By changing one train of gears conveniently located on the outside of the machine, the range of feeds may be doubled. The hand changes for the feeds are obtained by means of tumbler levers, conveniently located at the front of the machine. The ratio of the second feed to the first feed is constant. The third feed is independent of the first two, and any desired combination may be obtained. The changes obtainable on the machine give the proper lead for cutting from 20 to four threads per inch, using automatic collapsing taps or automatic opening die heads. Any one of the three feeds can be obtained automatically at any time. The feeds are independent of the high constant speed for idle movements of the turret slide while withdrawing, revolving and advancing the tools to the point of cutting.



Potter & Johnston No. 8-B Manufacturing Automatic

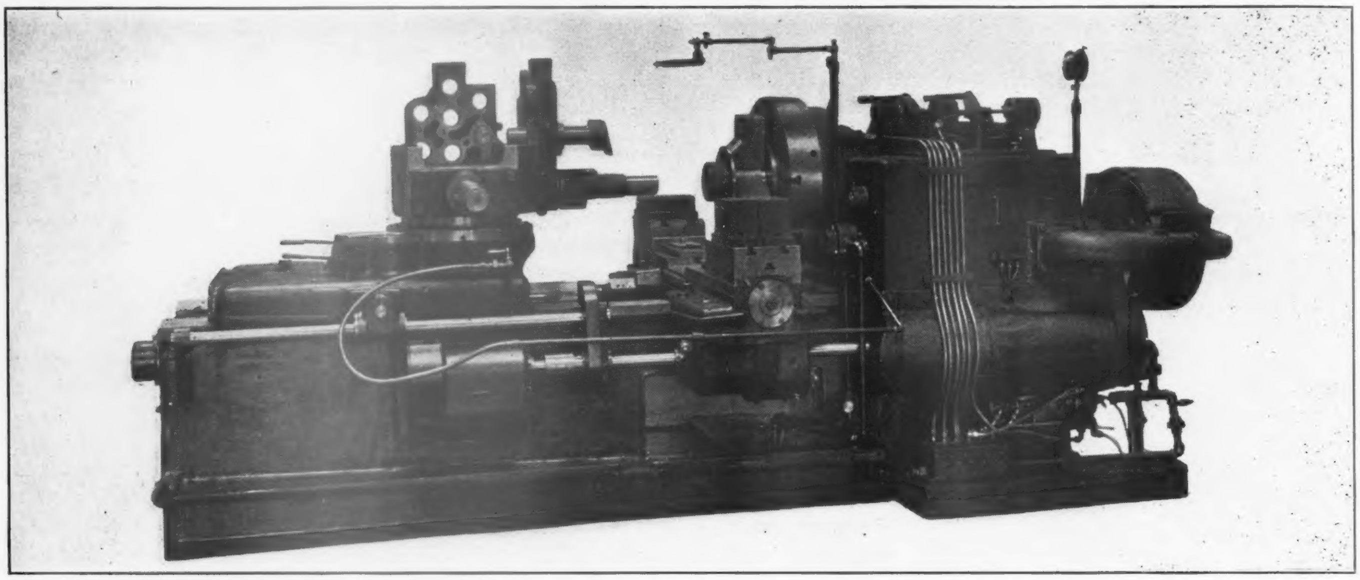
The cross slide is provided with front and rear blocks and two pairs of tool posts are furnished with each machine. The front and rear cross slide operate independently by screw feed, having a feed of 10 in. and can be arranged to feed into the work at any predetermined time, and at any desired relation, one to the other. The turret slide is of rugged construction and travels on ways so designed that all wear will be even and will not affect the accuracy of the machine. The turret slide has a 28-in. feed and no allowance needs to be made for revolving, as the turret revolves at the extreme end of its travel. It has 13-in. lon-

gitudinal adjustment by means of a hand crank and is securely clamped in any desired position by three bolts, besides being located by the adjusting screw.

The turret has four stations upon which tools may be mounted, and with each machine an outfit of turret turning tool holders, stems and cutters is furnished. Turrets with five or six faces may be furnished if desired. The turret is revolved by power through an intermittent pinion and gear and is so designed as to give an easy stop and start, the turret being stopped when the lock bolt engages, thus removing any shock from the lock bolt. It is clamped into position by a powerful binder working on the largest diameter of the turret seat. Levers are conveniently placed to release the binder and lock the bolt so that the turret can be revolved by hand. Both cross and turret slides are adjusted in relation to each other by conveniently placed clutches.

All operation of the speed clutches, feed and quick return clutches is done by a patented method, operated by dogs located on the dog wheel or drum. This method gives instantaneous movement to the clutches and enables the feed, speed and quick return to begin at exactly the same place each time. An oil pump and piping and oil arrangement through the turret are furnished on machines handling material requiring a lubricant. A 24-in. three-jaw geared scroll chuck regularly accompanies the machine and is furnished with standard set of jaws and wrench. The chuck is provided with pilot bushings to receive pilot bars for supporting the tools during the cutting operation.

A swing of 35 in. is possible over the machine bed and 24 in. over the cross slide. The travel of the cross slide (front and rear separate) is 10 in. A 15-hp. motor is required to drive the machine, when motor driven.



Rear View Showing Cutting Lubricant and Oiling Systems

Universal Index Centers With 10-In. Swing

A UNIVERSAL index center made to swing work up to 10 in. in diameter has been placed on the market recently by the Simmons Machine Company, Albany, N. Y. This index center is shown in Fig. 1 with two extra index plates in the foreground. The spindle has a No. 10 B. & S. taper. The swivel block is graduated and the worm wheel diameter is five inches. The head and tailstock are regularly furnished with tongues ⅝ in. wide, but any width of tongue may be specified. The equipment includes three index plates, four ⅝-in. bolts, wrenches and an index chart.

If desired, the index center can be provided with a spiral cutting attachment illustrated in Fig. 2. By removing the extension arm, the head can be swung 90 deg. The front end is threaded 2 5/16 in., and has a 1 1/16 in. hole through

Fig. 1—Simmons 10-In. Universal Index Center

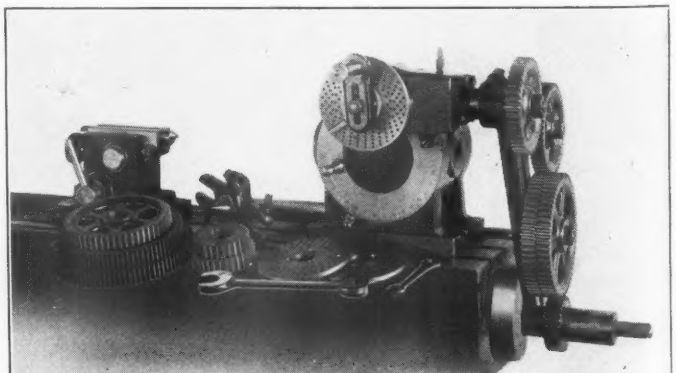


Fig. 2—Universal Index Center With Spiral Cutting Attachment

the entire length. The index crank is adjustable and all bushings are hardened. The gears are ¾ in. thick and have 1¼-in. bores. The equipment furnished is the same as previously mentioned. The Simmons dividing heads or index centers may be used on any standard milling machine adapted to tool room work.

Air Operated Combination Three-Jaw Chucks

THERE is undoubtedly a big field for the use of air operated chucks in railway machine shops, especially those that have been modernized and placed on a production basis. Probably the most useful application at the present time is to turret lathes, and Fig. 1 shows a three-jaw, air operated chuck thus applied. This chuck holds the work more securely than one operated by hand, which makes possible heavier cuts and increased feeds. There is also a big saving in chucking time and a resulting increase in production. The Logan chuck, illustrated, is being placed on the market by Frank E. Payson Company, Chicago, Ill., and is adapted to all types of lathes. The weight on the spindle is evenly balanced and the overhang is reduced to a minimum. The one-piece body construction gives ample strength. The improved jaw operating mechanism reduces friction and wear and insures a positive grip on the work that will hold under severe cuts and feeds. Dustproof joints between the draw tube and jaw slide keep dust and chips from working into the operating mechanism.

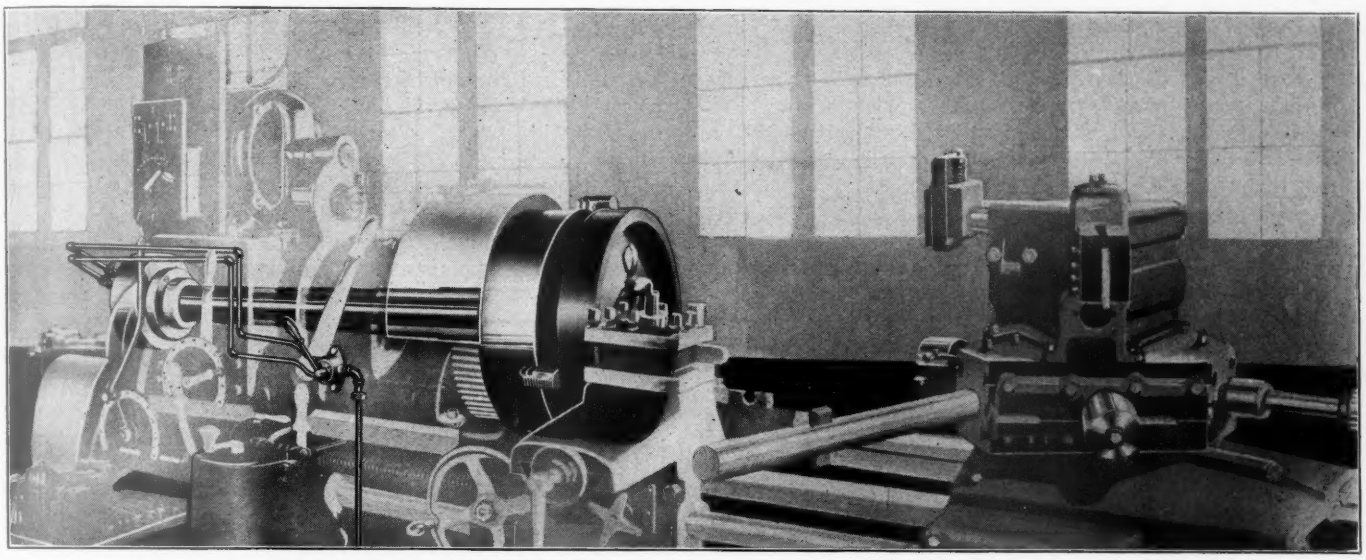


Fig. 1—Logan 24-in. Air Operated Chuck Applied to Heavy Duty Turret Lathe

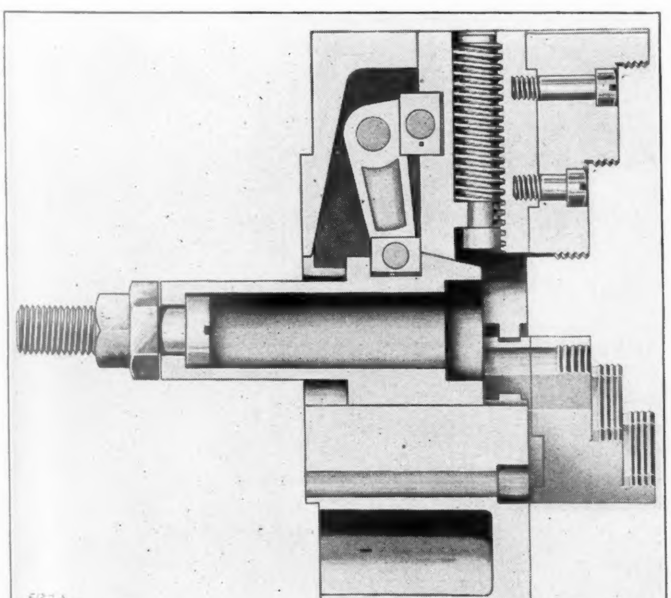


Fig. 2—Cross Section of Combination Three-Jaw Chuck

The combination three-jaw chuck, illustrated in Fig. 2, is provided with jaws which are adjustable and reversible. They can be set independently by a wrench or universally operated by compressed air in connection with the Logan double acting air cylinder. Master jaws with plain, soft steel blocks are regularly fitted to a steel or semi-steel body. A set of three-step reversible hardened steel jaws to fit the

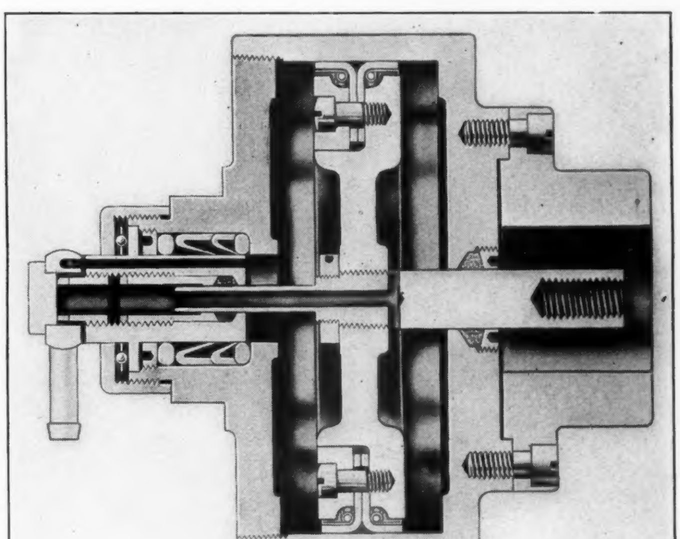


Fig. 3—Logan Double Acting Air Cylinder

master jaw can be provided if required. Attention is called to the one-piece body construction, the convenient, adjusting screw, the chrome nickel steel lever, and the fact that the draw tube and jaw slide do not separate, making a dust proof joint.

A cross section of the double-acting air cylinder, Fig. 3, shows the Johns-Manville type of packing cup and expander ring. The general arrangement of the cylinder is indicated and it is stated that leaking in the air shaft, a prevalent trouble, particularly in high speed machines, has been entirely overcome. This cylinder can be used on a machine running at a constant speed of 1,500 r. p. m. without overheating or requiring much attention. When the air is applied it enters an air channel between the outside of the piston and the inside of the expander ring, increasing the pressure against the cylinder bore and preventing air leakage.

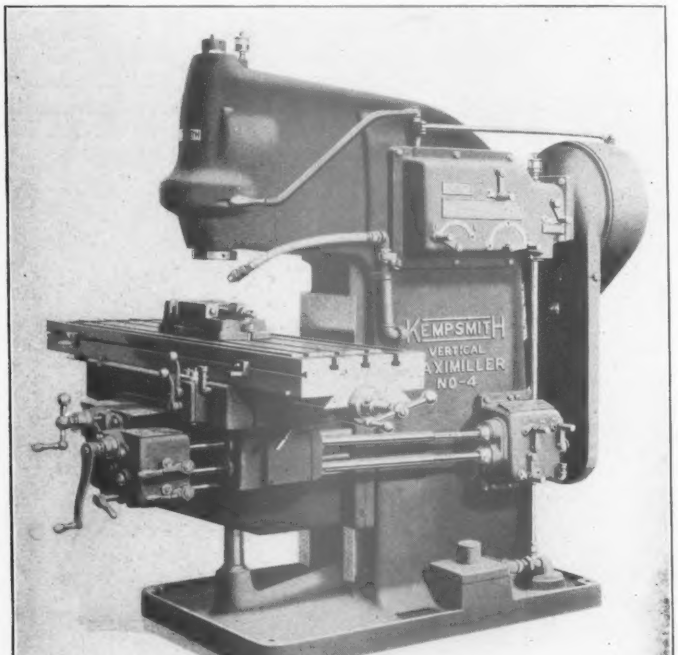
The air valve is shown in Fig. 1 and consists of a semi-steel body with a hand-lapped bronze taper plug operated by the handle shown. The parts are easily accessible for oiling or cleaning without disconnecting air pipes. A reversible handle enables the valve to be located in any desired position on the machine.

A Powerful Vertical Type Milling Machine

FOR many kinds of work the vertical type milling machine has important advantages over the horizontal type. With this fact in mind, the Kempsmith Manufacturing Company, Milwaukee, Wis., has designed the No. 4 vertical Maximiller which embodies several of the features of the horizontal type Maximiller previously described in the March, 1919, *Railway Mechanical Engineer.*

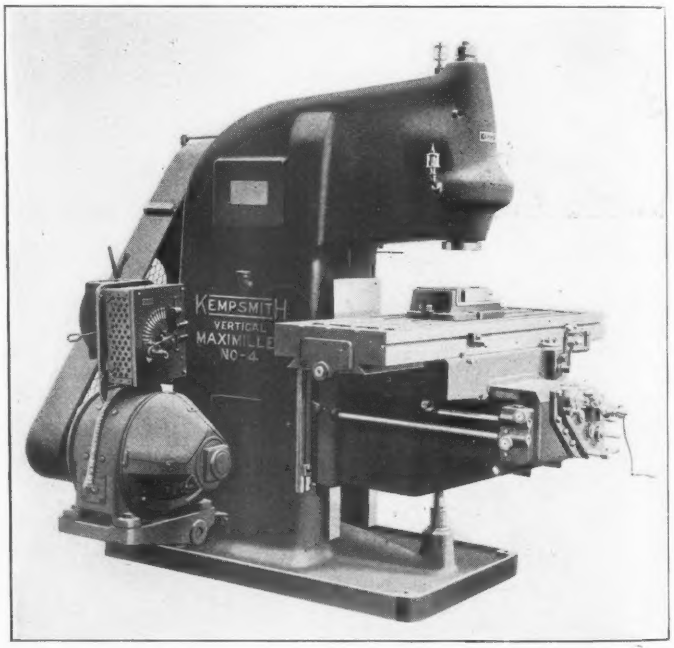
Special attention paid to securing a rigid machine has reduced vibration to a minimum and the entire design has been made with a view to maximum power, convenience of operation and quality of work. The main frame members of the machine, including the column, knee, saddle and table, are of semi-steel, with every effort made to secure strength without adding more metal than necessary. The column has few and small openings. It is well ribbed and has a rib midway of the column height, forming a reservoir for the speed drive oil. This rib also has a stiffening effect on the column.

The design of the knee is the same as that used on the horizontal machine, and there is no opening at the top, merely



View Showing Machine Arrangement for Motor Drive

a shallow depression to receive the center drive cross feed screw. The side walls also are practically solid, having but three small openings. This solid construction serves to resist clamping strains and the torsional effects of the table overhang. The knee, table and saddle are counterweighted by means of weights inside the column. Easy vertical adjustment of the work in relation to the cutter makes an auxiliary vertical slide for the spindle unnecessary. The table has a working surface of 70 in. by 18 in. and a longitudinal range of 42 in. Table wear is taken up on adjustable taper gibs with locked adjustment. Face milling cutters may be driven in either direction and the spindle nose construction permits cutters to be set up or removed easily. A spindle reverse has been incorporated for the reason that, in order to get cutting



Kempsmith No. 4 Vertical Type Maximiller

strains in the proper direction on the gibs and tables, a face mill must be run in the opposite direction to a spiral or slab mill. The spindle reverse of this machine is controlled by a single lever conveniently located.

The No. 4 Maximiller is arranged with power quick traverse, giving a 100-in. per min. travel of the table in either direction and a vertical movement of 36 in. per min. The traverse control is concentrated, and it is unnecessary for the operator to change his position in operating any of the quick traverse and feed movements. In case of error on the part of the operator in engaging wrong levers, the machine is amply protected by safety devices.

Eight changes of feed are provided, ranging from 5/8 in. to 25 in. per min. in geometrical progression. The gears are all heat treated and proper safety devices are incorporated throughout to prevent exceeding the maximum safe load. Particular attention has been paid to the question of lubrication, and the gears and shafts in the entire speed and feed mechan-

ism run constantly in oil. The balance of the oiling system is centralized at two points, so that none will be overlooked. For the circulation of the proper amount of cooling compound, a pump of 15 gal. per min. capacity has been provided.

A change in the power quick traverse rate does not affect the speed rate of the cross and vertical movements, and the quick traverse is available even if the spindle and feed are not operating. This is an advantage when setting up the machine or in returning the table after a completed cut has been taken. The machine is regularly arranged for single-pulley drive, but at an additional cost it can be arranged for motor drive through a belt, in which case a 15 h.p. motor, running at 1,200 r.p.m., is required.

The longitudinal, transverse and vertical ranges are 42 in., 14 in. and 20 in., respectively. The distance from the spindle to the table, in the lowest position, is 22 in. and the throat distance is 19 in. There are 18 spindle speeds, ranging from 14 to 355 r.p.m. Eighteen feeds are provided, which range from 5/8 to 25 in. per min. Owing to the power and convenience of operation of the No. 4 vertical Maximiller, it should be well adapted to the heavy milling machine requirements of railway shops.

Machine for Correct Tap Grinding

GRINDING a tap consists usually of grinding the taper at the end of the tap and the clearance back of the cutting edge thus formed. This taper may be long, as in nut taps, short, as in plug taps, or almost none, as in bottoming taps. The principle remains the same in each case. What is required is that each flute shall have exactly the same taper, just enough clearance so that it will cut freely, and not enough to needlessly weaken the cutting edge.

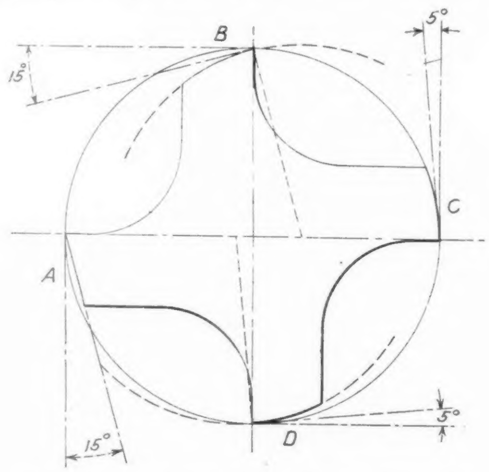


Fig. 1—Correct and Incorrect Tap Clearance

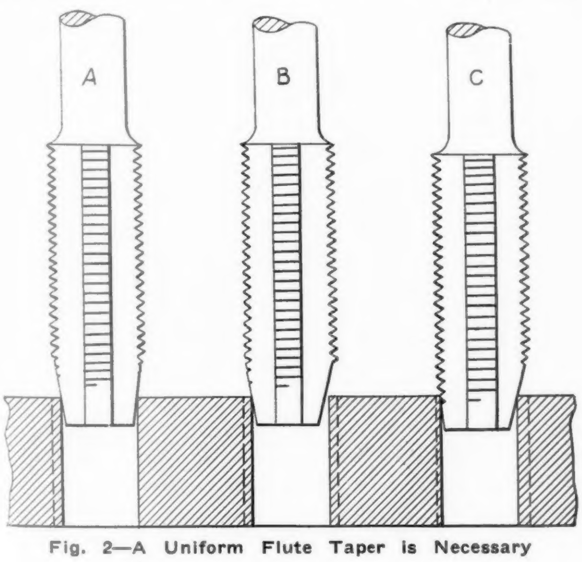


Fig. 2—A Uniform Flute Taper is Necessary

Prior to the advent of tap grinding machinery nearly all taps were ground by hand with a resultant lack of uniformity in taper and clearance. The accompanying diagram, Fig. 1, shows a section of a four-flute tap with each flute ground differently in the matter of clearance or backing off. The flute *A*, at the left, is ground with a straight line clearance just sufficient to have the heel of the flute actually clear and not drag. This calls for an angle of 15 deg., as indicated, and results in a weak cutting edge, but the strongest possible with a straight line clearance at the heel.

The flute *B*, at the top, shows a 15-deg. convex clearance. A glance shows this to be excessive. Flute *C*, at the right, shows a straight line clearance of five degrees, and nearly half of the flute at the back is not cleared at all, leaving the tap to ride on that portion and keep the front of the flute from cutting. Flute *D*, at the bottom, shows a perfect grind for ordinary work. It is a five-degree convex clearance and shows that with this small but sufficient clearance angle at the cutting edge, the back is perfectly cleared.

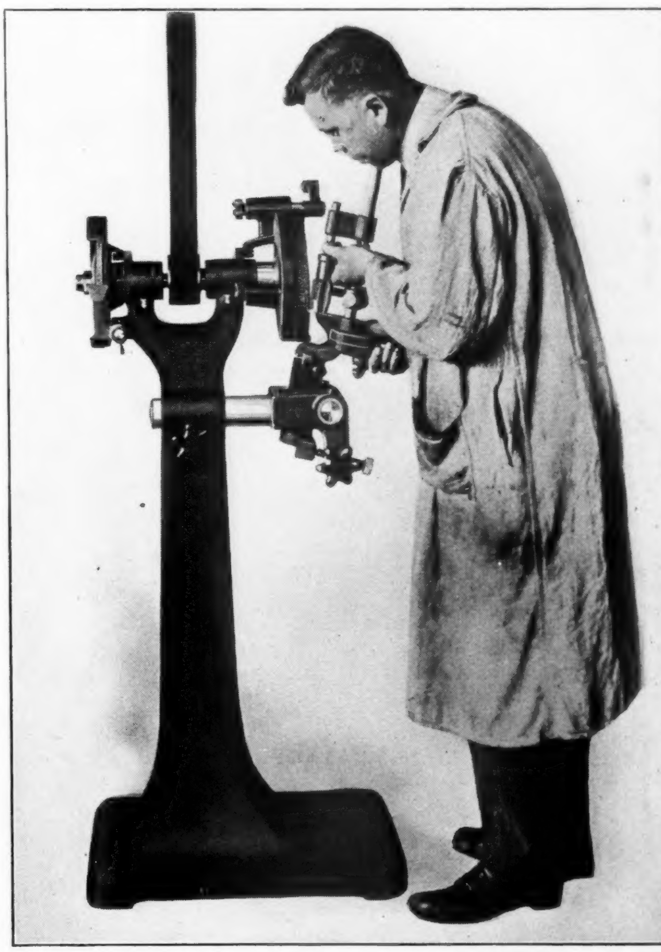


Fig. 3—No. 2 Grand Rapids Tap Grinding Machine

In addition to the correct clearance of taps a uniform angle of taper for all flutes is necessary. The results of different tapers obtained by hand grinding are indicated in Fig. 2. Even a slight variation from the uniform taper angle means power wasted and taps broken. As the blunt angle flute strikes the side of a drilled hole, it throws the cutting end of the tap off center and imparts to it a wabbling motion. This means a tapped hole that is oversized, allowing the screw to fit loosely. Tap A is correctly ground and will tap a hole true to size, properly located and with smooth, accurately shaped threads. Tap *B* is ground with one flute at a more blunt angle than the other. This blunt flute is shown just as it strikes the drilled hole. Tap *C* shows a similar tap after it has been crowded over. The condition developed is readily seen.

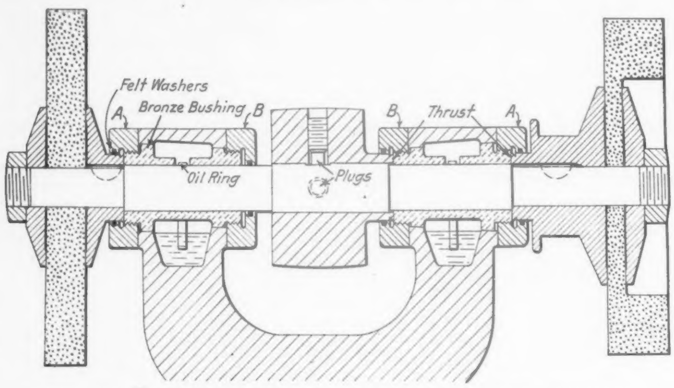


Fig. 4—General Arrangement of Spindle and Bearings

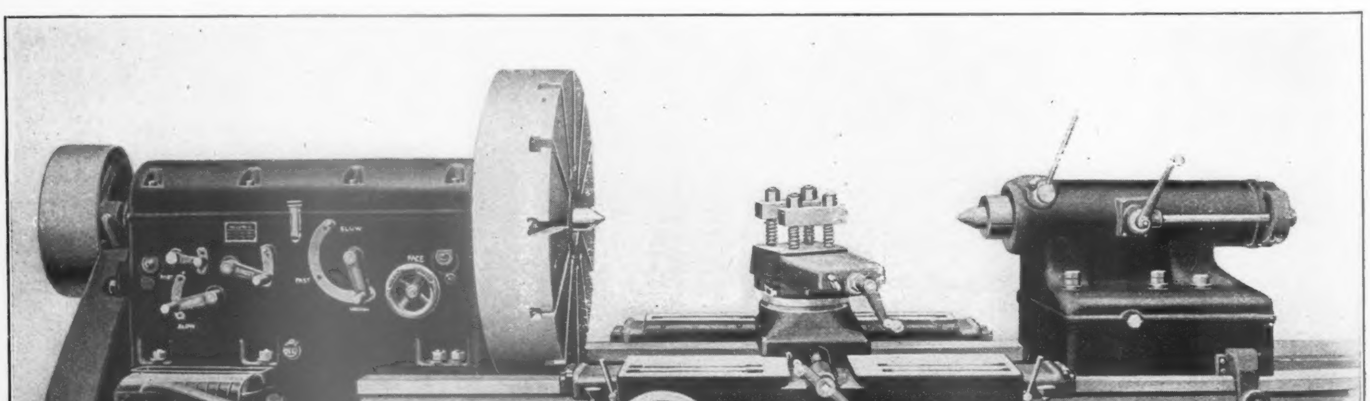
In the interest of longer life for taps and more correct work with less power consumption and fewer broken taps, the Grand Rapids Grinding Machine Company, Grand Rapids, Mich., has developed a line of machines for grinding taps. These machines are made in four styles for grinding all kinds of taps except possibly certain kinds of stay bolt taps. The No. 2, illustrated in Fig. 3, has a capacity to grind from 3/8-in. to 3-in. taps. The operator has the machine set for the proper taper and is shown grinding the tap flutes. By means of this machine the proper clearance, in the form of an arc of a circle, can be ground on any standard tap.

As with any grinding machine the spindle and spindle bearings are important, and their general arrangement on the Grand Rapids tap grinder is shown in Fig. 4. The spindles are of high carbon heat treated steel and run in dustproof phosphor bronze bearings with oil-tight adjusting collars, which prevent oil leakage. The machines are of rigid construction, being both simple to understand and easy to operate.

Nine Speed Geared Head Engine Lathe

To meet modern requirements, a new, all-geared lathe head has been designed by the Betts Machine Company, Rochester, N. Y., and applied to the company's full line of heavy duty engine lathes, ranging from a swing of 32 in. to 48 in. The new headstock is of the all-geared, enclosed type, operated by a powerful expanding ring friction clutch upon which the driving pulley is mounted. The clutch is operated from the apron and the same movement which disengages the clutch, automatically applies the friction brake, thereby stopping the machine with no loss of time.

Nine spindle speeds including three direct, three back gear and three triple gear speeds, are obtainable quickly and are controlled by three levers located on the headstock within easy reach of the operator. All speed changes are in geometrical progression and are obtained through hardened steel sliding gears and positive clutches running in oil. The edges of the gear teeth are rounded to allow for quick and easy engagement. There are 12 gears, including the face plate and pinion gear in the headstock. All back gear and triple gear speeds drive through the face plate gear, the driving pinion of which can be disengaged when using direct spindle speeds. An interlocking device is provided so that no two speeds can be engaged at the same time.



Betts-Bridgeford High Power Engine Lathe with All Geared Head

All shafts and gears are located in the lower half or base of the headstock and not in the cover, which allows easy access to all of the parts, it being necessary only to remove the

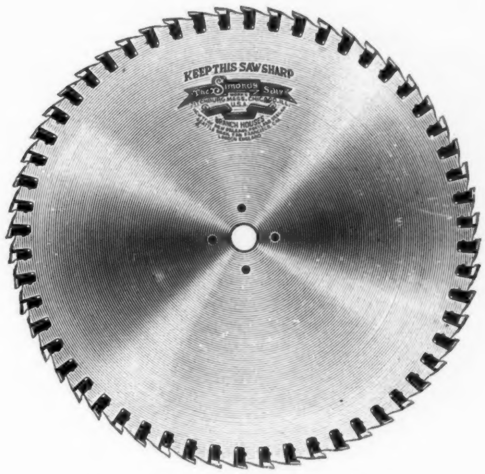
cover. All the shaft bearings are bronze bushed and lubrication is obtained by a pump located in the headstock and distributing oil to all of the bearings. This reduces the possibility of any bearing running dry as long as the oil is maintained at the designated height. When desired the lathe can be arranged for motor drive and in this case, the motor is mounted on top of the headstock cover and directly connected through gears to the main driving shaft.

Saw With Inserted High Speed Steel Teeth

A LINE of metal cutting saws with inserted high speed steel teeth has been placed on the market by the Simonds Manufacturing Company, Fitchburg, Mass. Among the advantages claimed for this saw may be mentioned a reduction in wear on the saw blade and the fact that when the teeth wear down they may be replaced by new ones, the diameter of the blade not being changed. Moreover, due to the inserted teeth of high speed steel, it is possible to make the body of a less expensive steel, with a resultant saving in cost.

Cold cutting saws are used in many railway shops, not only in the blacksmith shop for cutting up bar stock of all kinds, but in the machine shop for cutting out the fork ends of motion work and main rod straps. For these purposes high speed saws give a large production.

Simonds saws are now made in sizes as small as 10 in. in diameter. Up to 22 in. in diameter they can be made to cut a remarkably thin kerf, only 3/16 in. wide. Wider saws of this type are made in diameters up to 64 in.



Simonds High Speed Steel Saw

Electrically Driven and Controlled Planer

THERE is an increasing tendency in modern machine design towards electrical control and the resultant advantages in greater flexibility and ease of operation are most important. An example of electrical control in planer construction is afforded by the Hiloplane, manufactured by John Stirk & Sons, Ltd., Halifax, England, which company is represented in New York by Alfred Herbert, Ltd. A general view of the planer is shown, and among the interesting features may be mentioned a reversing motor drive by means of a special generator set, magnetic fields and the simplicity of setting the table stroke on a graduated dial, no table dog being employed for this purpose. An additional advantage is the possibility of cross planing.

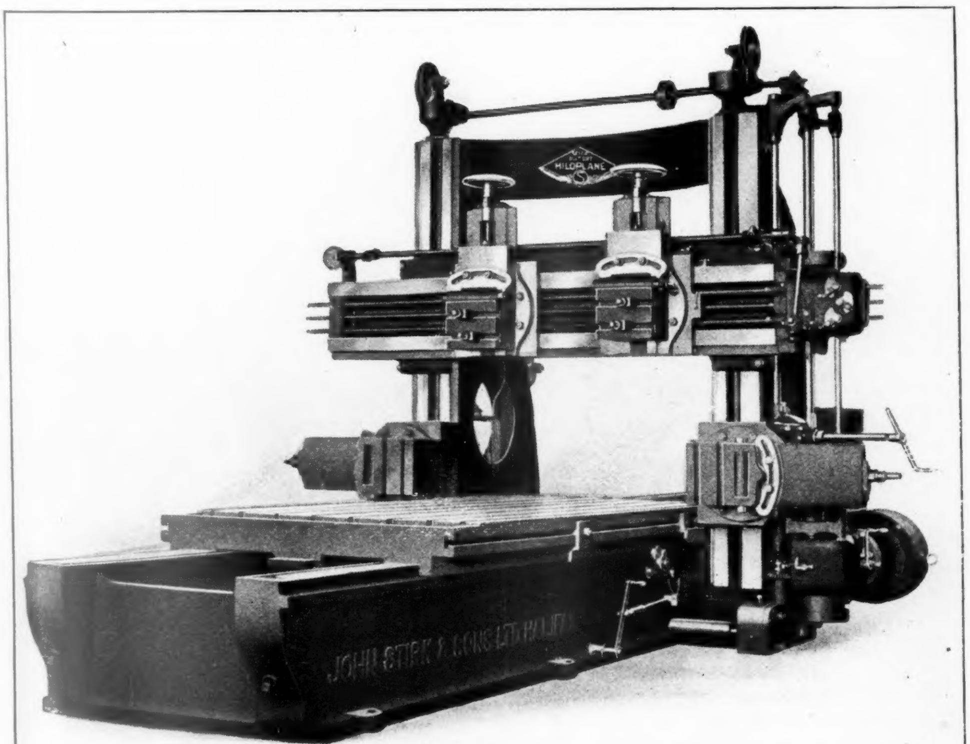


Fig. 1—Hiloplane Electrically Controlled Planer

It is possible to obtain high speeds with the electrically controlled planer, and on the other hand low speeds are available for special work. Particular attention is called to the magnetic feeds. A special motor generator set is used to supply current to the d. c. driving motor, and the latter is controlled by varying the field resistances of the former. The fields are excited independently and any variation in resistance changes the voltage with a corresponding change in armature speed. It is thus possible to obtain an infinite variety of speeds from a given normal speed down to zero. In practice the actual motor speed is seldom reduced more than 25 per cent on account of reduced torque. By adjusting the resistances in the fields, the upper limit of the reversing motor speed is usually increased, and any one of a large range of speeds can be obtained with the utmost ease. As previously stated, this wide range of speeds, taken with the sturdy construction of the planer,

makes the machine capable of maintaining the maximum speeds possible for ordinary duty on mild steel and also for extra heavy cutting at low and medium speeds on hard metal. Variations are made by the finest steps, and cutting speeds and return speeds are independently variable. A patent accelerating device is provided, by which the cutting speed may

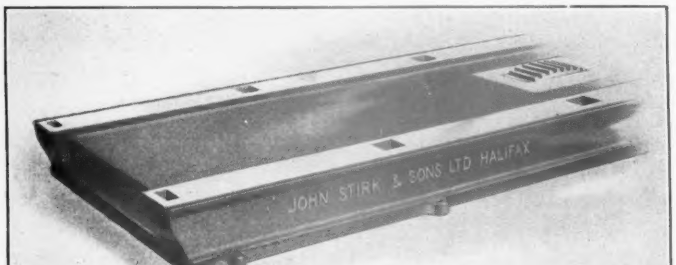


Fig. 2—Box Section Bed With Continuous Top Plate

be increased after the tool has entered the metal, or between surfaces. In this way gaps between surfaces may be quickly bridged which is an important advantage and time saver both in cases where the gap is between different pieces set up on the planer bed, and between two surfaces on the same piece.

A wide range of feeds is obtained by the magnetic feed control fitted to both the cross slide and vertical heads. By means of this arrangement variable and reversing self-acting

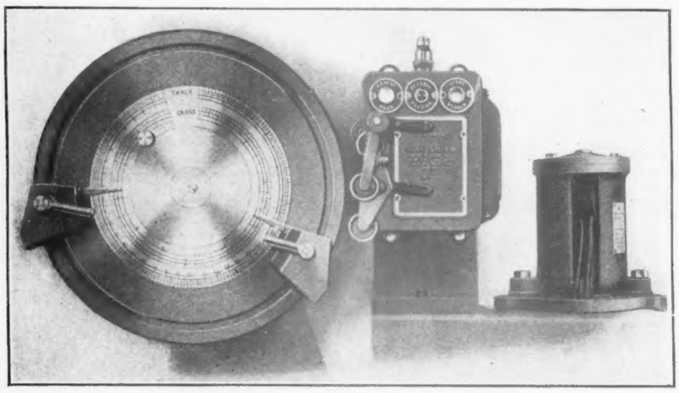


Fig. 3—Table Control Mechanism

feeds are obtained in horizontal, vertical and angular directions. Special provision is made for broad finishing cuts. The feed obtained depends upon the position of the handle in the horizontal slot shown in Fig. 4. A small separate feed motor shown in Fig. 4, is used for quick power traverse of the heads, which is obtainable in all directions. This also makes it possible to perform cross planing jobs, a valuable feature for short bosses on large pieces because it avoids an additional set up of the work.

The table control mechanism, illustrated in Fig. 3, is simple and the length of the table stroke is obtained by fitting stops on the graduated dial, instead of setting table dogs. The reversal of stroke is obtained by the action of the stop on a reversing switch. By means of this electrical control and the absence of table dogs, it is possible to obtain a stroke of 4 in. The table may be started or stopped from either side of the

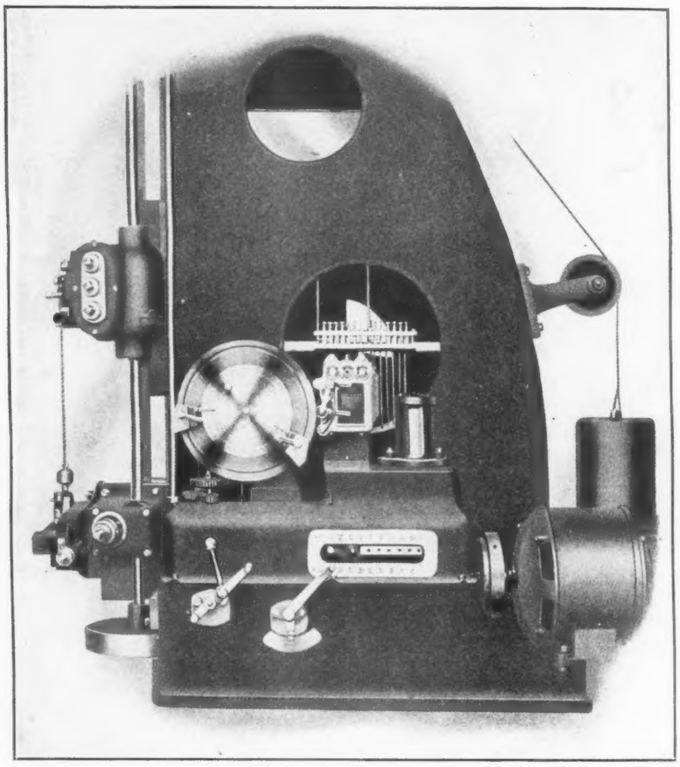


Fig. 4—View Showing the Magnetic Feed Control

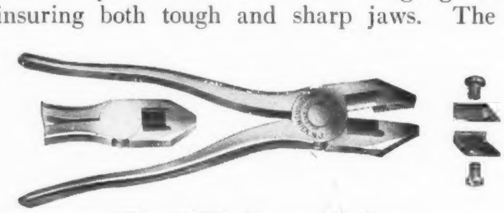
bed, and a hanging switch is provided for convenience in setting up. A safety switch arrangement also prevents the table from running off the tracks.

To insure safety at high speeds, the pinions are forged solid with their shafts. The motor generator set is not mounted on the machine but in a convenient position apart, thereby eliminating vibration. The control of the table is by a switch button for starting and stopping. Due to its flexibility and ease of control, this machine is adaptable to a wide variety of planing operations in machine shops where high production and accurate work are the ends in view.

Side Cutting Pliers With Renewable Jaws

PROBABLY the weakest point in the pliers ordinarily used by electricians and mechanics has been the jaws, and to overcome this weakness the Neverslip Works, New Brunswick, N. J., has developed a type of pliers with renewable steel jaws. This important feature makes it unnecessary to throw away a pair of pliers in case the jaws become broken or worn out. It is only necessary to remove the worn blades and insert new ones, which is a quick, inexpensive operation.

Another feature of the side cutting pliers, illustrated, is the fact that the method of making them in two parts permits the manufacturer to select the best possible steel for each purpose. The jaw blades are made of high grade crucible steel, insuring both tough and sharp jaws. The handles



Pliers With Renewable Jaws

are made of drop-forged steel, which reduces the chances of breaking under ordinary usage to a minimum.

Production Automatic Milling Machine

An automatic milling machine intended for the manufacture of duplicate parts in large quantities has been placed on the market recently by the Brown & Sharpe Manufacturing Company, Providence, R. I. It is essentially a manufacturing machine, known as the No. 21 automatic milling machine, Fig. 1. It has structural characteristics common to the other styles of plain milling machine of the column and knee type, but in the application of automatic control to that of a plain milling machine, many new and important features were developed.

By means of adjustable dogs on the front of the table, the control of the spindle and table is entirely automatic. These movements include a variable feed, constant fast travel and a stop for the table; start and stop, and right and left hand rotation for the spindle. The table and spindle may be operated independently of each other, and these movements may or may not be intermittent in either or both directions and may take place one or more times. The spindle may be stopped upon the return travel of the table, thus eliminating the possibilities of marring the work, and the spindle reverse allows the use of two sets of cutters, with teeth facing in opposite directions, so that one set may be in operation for one direction of table travel and the other set for the opposite direction of table travel. A constant fast travel and a slow, variable feed in both directions are automatically controlled by the table dogs.

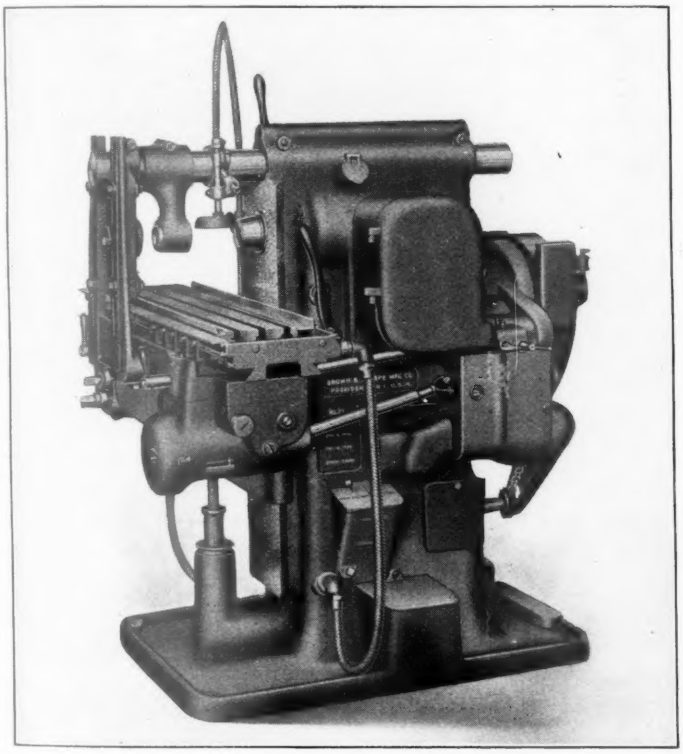


Fig. 1—Brown & Sharpe No. 21 Automatic Milling Machine

There are four different style dogs necessary to operate all the automatic movements of the machine, but for all ordinary milling operations, two or three of the styles are usually sufficient. A long dog *A*, Fig. 2, used at *A* or *B* controls the reversing of the table. This same dog also stops the table, if it is so desired, and the table stop lever is set. Dog *C* controls the constant fast travel, and dogs *D*1 and *D*2 control the variable slow feed, it being possible to set these dogs to operate in either direction. The variable slow feed dogs are trip dogs made changeable to operate, as shown at *D*1, when the direction of the table travel is to the right, and as shown at *D*2 when the direction of the table travel is to the left.

The table always moves at its constant fast travel when reversed, and when the machine is set for reversing the spindle, the spindle is reversed when the table is reversed. When the machine is set for stopping the spindle, the spindle stops when the table is reversed and starts with the fine variable table feed. No extra tripping dogs are required for either reversing or stopping.

Continuous milling operations may be performed by employing two *A* dogs and two *D* dogs, and for intermittent milling operations, dogs *A* and *B* and dogs *C* and *D* are employed, the number of pairs of *C* and *D* dogs depending upon the number of pieces of work on the table.

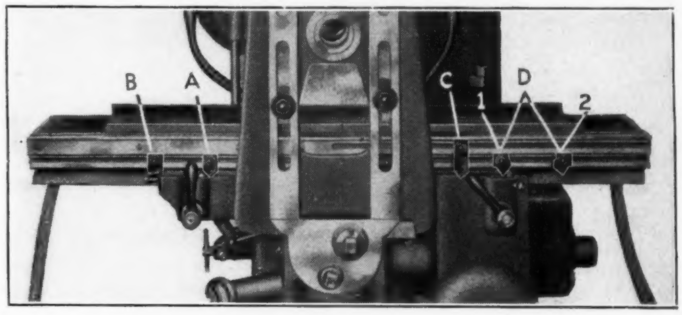


Fig. 2—Automatic Spindle and Table Control is Secured by Adjustable Dogs

Although the automatic control of the spindle and table is by means of table dogs, the same results may be attained by hand, employing the two controlling levers located on the front of the saddle. Occasionally the loading time of a piece exceeds the cutting time, and the table is set to stop for the safety of the operator. Under these circumstances the machine is semi-automatic in operation, and the hand control levers are employed in place of the dogs.

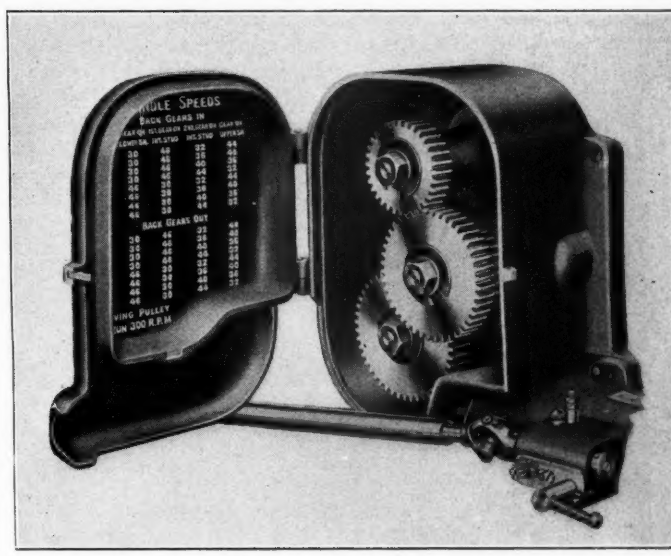


Fig. 3—Spindle Speed Change Gear Case

Manipulation of the controlling levers is extremely simple, and the ease and rapidity with which they may be operated is in some cases faster than when it is fully automatically operated. By means of the hand-control levers, the machine may be operated as a plain milling machine.

The constant speed type of drive permits the machine to be driven by a belt directly from the main shaft to the single-

driving pulley. Mounted upon the drive shaft are the friction clutches for starting, stopping and reversing the spindle automatically, and this arrangement relieves the spindle of all unnecessary weight. Power is transmitted from the shaft to the spindle through a series of spiral bevel gears, which furnishes a smooth and powerful drive.

Another advantage of the constant speed type of drive is the complete separation of the spindle speeds and the table feeds, permitting any combination of the two within the capacity of the machine. Variations of the spindle speeds are obtained through change gears, giving 16 changes of speeds in geometrical progression from 28 to 695 r.p.m. in either direction. The table feeds are positive and are entirely independent of the spindle speeds. There are 12 changes, ranging from 1.37 in. to 18.38 in. per minute. This provides a range of 0.002 in. to 0.050 in. per revolution of the spindle for small mills and 0.026 in. to 0.656 in. per revolution of the spindle for large mills. Both sets of change gears are contained within heavy cast iron cases and are made readily accessible by doors, upon which are cast tables of the proper gears for the various spindle speeds and table feeds. The spindle speed change gear case is shown in Fig. 3.

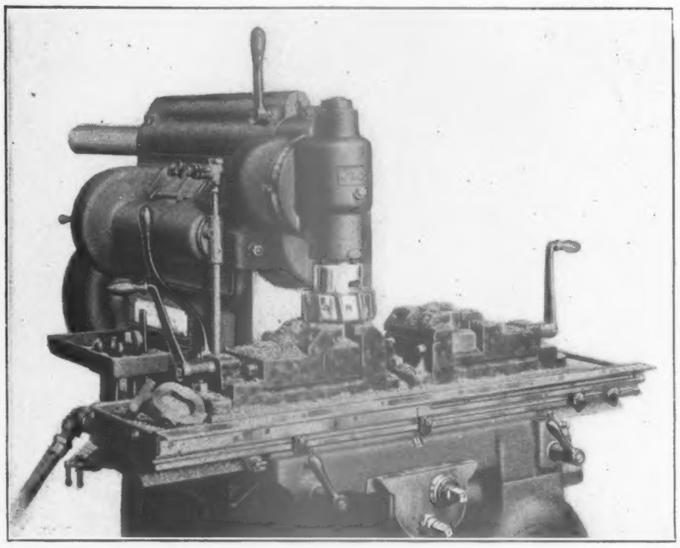


Fig. 4—View Showing Adaptability for a Vertical Milling Attachment

When motor drive is desired, the motor is placed at the rear of the machine where it is completely out of the way and does not increase the floor space occupied. In this case the motor is mounted on a heavy bracket firmly bolted to pads provided on the base of the machine. A belt transmits the power from the motor to the single driving pulley and a cast iron guard protects these parts from dust and grit and the operator from injury.

The front end of the spindle is tapered, hardened and ground and has a recess to receive a cutter driver and clutch on arbors and collets. The reverse gearing and cams, actuated by the table dogs are assembled as a unit in an oil tight case and this unit of mechanism is automatically lubricated and protected by a safety friction coupling set to slip at a predetermined load, thus guarding against possible damage. The other unit of mechanism that responds to the action of the table dogs is that which controls the constant fast travel of the table and the variable table feeds. This unit is provided throughout with ball bearings and is also automatically lubricated, being contained within an oil tight case. The adaptability of the machine for use with a vertical milling attachment is illustrated in Fig. 4.

The automatic lubrication of all rotating parts within the frame of the machine is another important feature. Filtered oil is pumped to a reservoir cast in the top of the frame and by means of pipes and a gravity system oil is constantly distributed to the various bearings. For manufacturing purposes an abundant supply of cutter lubricant is pumped from a large tank located within the base of the machine.

Realizing the importance of a rigid construction in a high productive machine of this type, the designers have embraced features adapted to these conditions. The column, knee, and table, are provided with internal bracing and reinforcing ribs. The wearing surfaces of the table and bearings throughout the machine are of such proportions as to provide for the severe service to which a strictly manufacturing machine is subjected.

The machine has a longitudinal table feed of 22 in. and transverse adjustment of $6\frac{1}{2}$ in. with a vertical adjustment of $14\frac{1}{2}$ in. The spindle is provided with a No. 10 taper hole. The speed of the drive shaft is 300 r.p.m. and the power consumption is 5 hp.

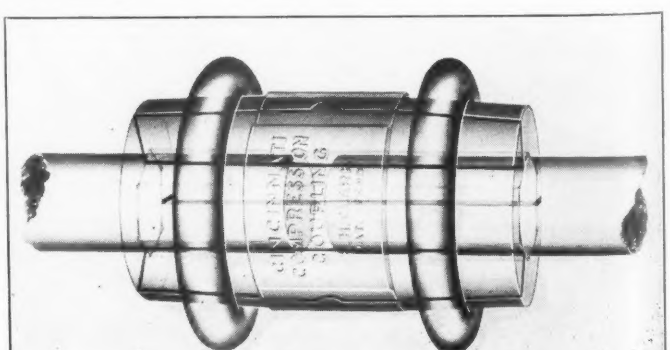
Compression Coupling Saves Time and Labor

A MATERIAL saving in the time and labor heretofore required for connecting line shafting can be effected by the use of a new compression coupling manufactured by the Cincinnati Ball Crank Company, Cincinnati, Ohio. The outstanding features of the coupling are simplicity, ease of application and adaptability to all standard shafting.

In construction, the coupling shows a radical departure from the old type of flange and bolt connection. It consists of only five pieces; three jaws, and two clamping rings. The jaws of the coupling are set in position about the shaft, and held in place by the longitudinal grooves and notches that lock them together. The forged clamping rings are pushed on over the tapering ends of the jaws, and hammered tight.

A hammer is the only tool required to apply the coupling, no dismantling or machining of the shaft sections being needed. The only requirement is sufficient clearance between the sections to allow the clamping rings to pass.

The coupling grips the joined sections of the shaft, holding them in alinement. The round, machined sections of the tapered end of the coupling jaws form lines of contact for each ring, and once driven into place, it is practically impossible for the coupling to become loose. Compression couplings of this type have been in use three years with no adjustment since their installation.

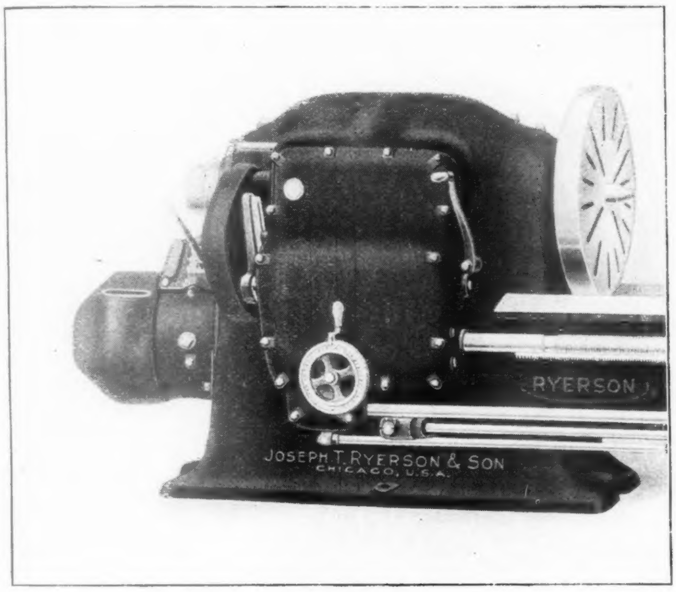


Cincinnati Compression Coupling

The assembled coupling forms a clean, compact shaft joint with no projections on its outer surface to catch a workman's clothing, thus insuring safety for employes. When used as a reducing coupling, the only additional parts needed are three strips of cold rolled steel to fit between the smaller shaft and the inside of the coupling jaws. The couplings are made in sizes to couple shafting from 15/16 in. to 3 in. in diameter.

High Power Selective Head Engine Lathe

A well balanced line of engine lathes, designed for quantity production as well as general machine shop work, has been placed on the market recently by Joseph T. Ryerson & Son, Chicago. The machines are made in five different sizes, including 15-in., 18-in., 22-in., 27-in. and 33-in. swing, with any length of bed. A notable feature in the design is the method of driving. With very slight changes the lathe can be adapted to constant speed single pulley drive, with or without spindle reversing attachment, or direct reversing motor drive. In the latter arrangement the motor is bolted to the bed and the armature shaft connected directly to the main driving shaft, doing away with belts, tension idlers and chain drives. The changing from belt to motor drive or vice versa can be made at any time and at a small cost.



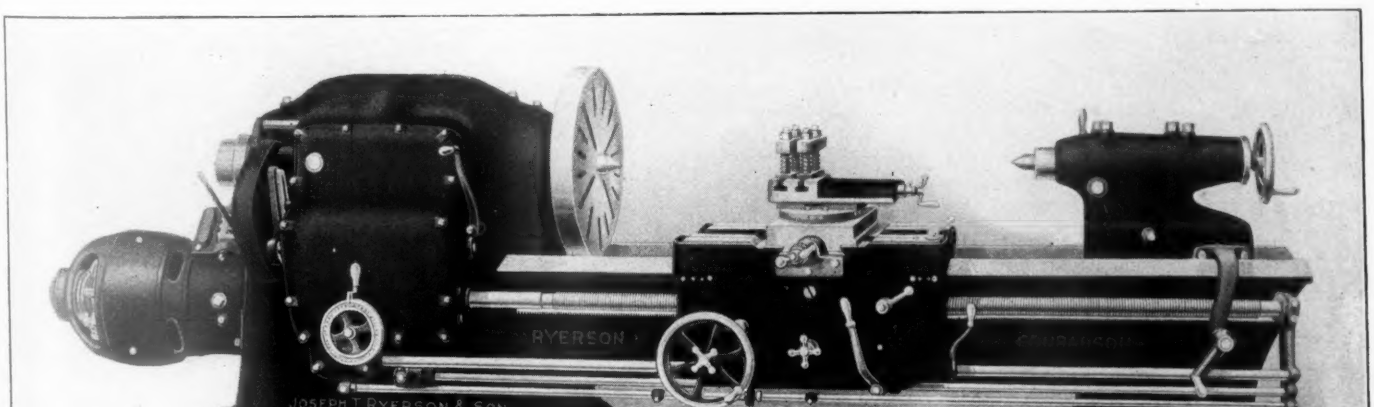
Single Pulley Drive Arrangement

For convenience in operation and cutting down all possible lost motion, the lathe controls have been centralized on the apron, and from one position the operator may start, stop and reverse the spindle instantly, engage, reverse or trip the feed, as well as traverse the carriage and cross slide. The 12 spindle speeds are changed by means of two levers on the headstock, one of which controls the various sets of change gears and the other the back gears. The action of both levers is practically instantaneous, and all changes may be made while the lathe is in operation. The handwheel, shown on the headstock, can be turned to any desired feed marked on its circumference, automatically selecting the feed indicated.

To secure greater rigidity, the lathe headstock has been cast integral with the bed, the latter serving as a container for oil, in which part of the gears run. All gears are lubricated by the splash oil system. The spindle is proportionately large in diameter to eliminate vibration as far as possible, and a ball thrust bearing takes up the heavy working strains. Power is transmitted to the spindle through a phosphor-bronze driving pinion and a large herringbone gear. This type of drive reduces back lash to a minimum and gives a steady driving torque. The back gears, as well as all change gears, are permanently in mesh, and all changes can be performed with rapidity and without danger of engaging more than one set of gears at a time.

The spindle drives a large spur gear connected to the feed-reversing mechanism, which is operated from the apron. Twenty-eight feeds are obtained by two sets of geared cones, which in turn are actuated by a handwheel and lever on the headstock. The carriage longitudinal and cross feeds are effected by independent sets of worm gears which are engaged by large friction cones. The positive feeds consist of a large split nut made of phosphor-bronze and an effective safety device is provided. One lever on the apron controls the starting, stopping and reversing of the spindle, and one lever controls the engaging, tripping and reversing of the feeds. Arrangement is made to automatically trip either the friction or the positive feeds at any point along the carriage travel.

Particular attention has been paid to the cross sections and



Motor Driven Engine Lathe Designed for High Production

proportions of the ways of the bed. The guiding surface of the vees is inclined at 15 deg. to the perpendicular and the supporting surface at 15 deg. to the horizontal. The vertical depth is at least twice as great as in the usual construction and, due to the broad supporting surfaces, the wear on the carriage and ways is reduced to a minimum. The usual extra attachments can be supplied with the new Ryerson-Conradson lathe, if required.

Boring Mill for Heavy Accurate Work

ONE of the most desirable characteristics of a machine tool designed for railway shop work is the ability to stand up under heavy roughing cuts in tough steels, and possibly in the very next operation produce some machine part to a fine limit of tolerance. It would be difficult to devise a more strenuous test of a machine tool's ability to render consistent service on all classes of work within its range and yet, the above test is one which must be met every day in railway machine shop work owing to the widely divergent character of the machine operations to be performed.

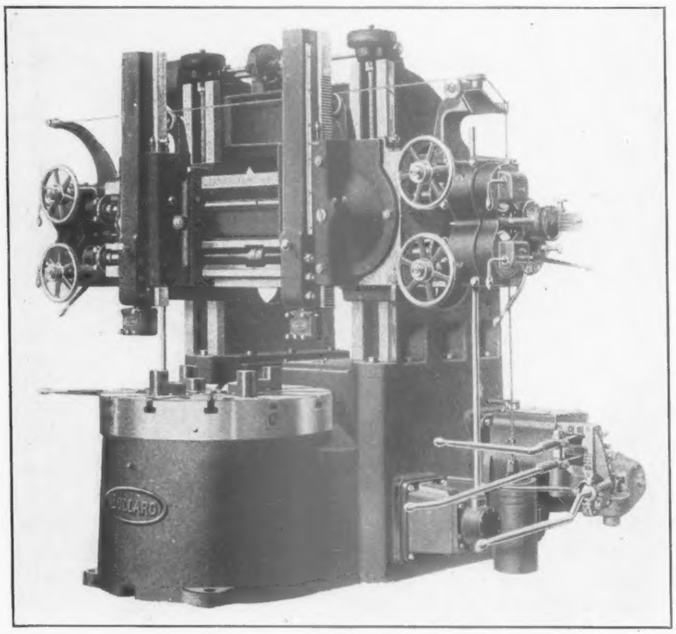


Fig. 1—Bullard 44-In. Maxi-Mill

Equal facility in taking cuts up to its maximum capacity or doing work requiring a high degree of accuracy is possessed by the 44-in. Maxi-Mill illustrated in Fig. 1. This new machine, made by the Bullard Machine Tool Company,

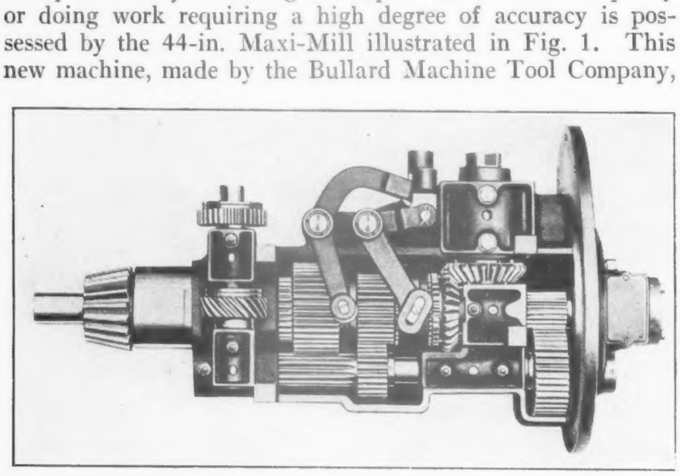


Fig. 2—Improved Secondary Speed Change Case

Bridgeport, Conn., is the smallest one of a line of boring mills embodying the principles of unit construction, centralized control, continuous flow lubrication, and cutting lubricant system previously described in the June, 1918, *Railway Mechanical Engineer.*

Certain improvements have been made in the secondary speed change case, shown in Fig. 2, to secure a power unit of maximum strength and durability.

The most important improvement in the new design is the

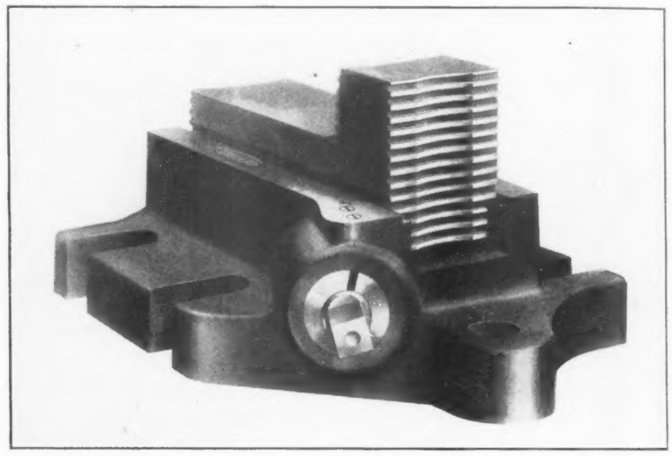


Fig 3—Bullard Independent Face Plate Jaw

use of two driving gears, rigidly keyed to the drive shaft instead of sliding upon it. The clutch gears have internal teeth meshing with spur gears and form a positive lock. The gears are all of relatively greater size and so guided upon their mating gears as not to produce braking shocks when shifted.

A plain table with radial T-slots, three-jaw combination

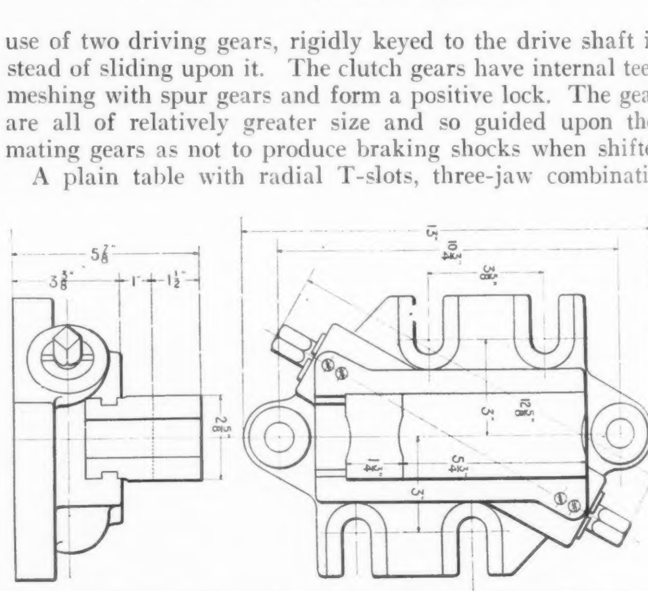


Fig. 4—General Dimensions of Independent Face Plate Jaw

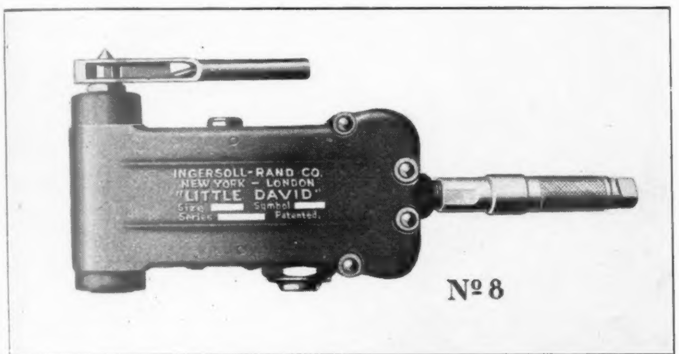
chuck, or four-jaw independent chuck, may be provided with the 44-in. Maxi-Mill. Both the three and four-jaw chucks are powerful and have been developed to meet the exacting requirements of the vertical turret lathe. The chuck bodies are heavily proportioned to avoid distortion and operating parts are made of selected materials best suited to the service required. The sliding jaws are of forged steel accurately fitted to the chuck body and special arrangement is made to prevent foreign matter getting into the operating mechanism, which is packed with non-fluid oil and graphite. The top jaws are adjustable, mounted on sliding members and may be reversed or removed readily.

In case odd shaped pieces are to be machined, or work that is off center, the best arrangement is to use independent face plate jaws in conjunction with a plain table. These jaws, one of which is illustrated in Figs. 3 and 4, are both convenient to operate and great time savers. They are not limited to machines having the Bullard standard arrangement of T-slots.

The bodies of the independent face plate jaws are made of drop-forged steel. The top jaw, Fig. 3, is made of special steel, and is not liable to distortion or fracture under severe service. The actuating screw being placed at an angle with the jaw gives a powerful differential movement, which resists any backward strain or tendency to loosen the jaw when under cut. This arrangement also permits the operator to use a wrench on either end. The jaws are securely held to the slots of the table by two bolts and are reversible.

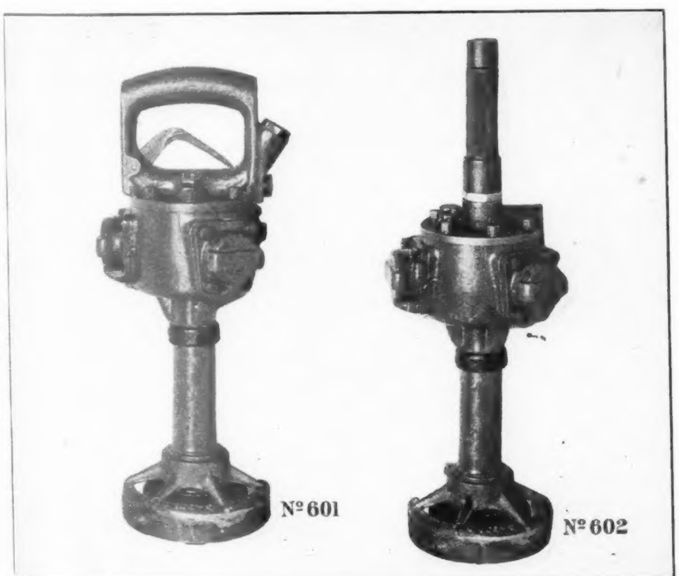
Small Portable Pneumatic Tools

SEVERAL new sizes of small portable tools have been added recently to the line of "Little David" pneumatic tools manufactured by the Ingersoll-Rand Company, New York. The new tools, as shown in the illustrations, include a No. 8 small close quarter drill, two small high speed pneumatic grinders, No. 601 and No. 602, and two lightweight drills, No. 6 and No. 600. It is poor economy to use heavy pneumatic tools for light work and the lightweight, high speed machines described in this article are well adapted to railway shop work often done with heavier equipment.



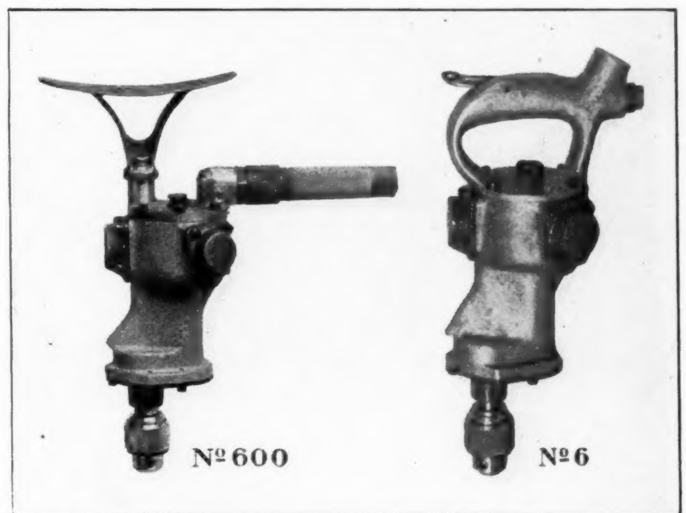
Ingersoll-Rand Close Quarter Drill

The close quarter drill is for use in a limited space close to a wall or corner. This new machine has a fairly high speed, running at 250 r.p.m. without load, but will handle drilling, reaming or tapping up to 1¼ in. diameter. The tool is specially designed throughout for close quarter work and has several unique features. The spindle which turns the drill, reamer or tap, is operated by three rocking levers connected directly to the pistons through connecting rods. The motor is of the three cylinder type with pistons acting at right angles to the levers. A steady, continuous movement of the spindle is obtained, as one ratchet pawl is always in contact with a tooth of the spindle. The construction is simple and sturdy, with the least number of parts consistent with approved design.



High Speed Pneumatic Grinders

The No. 601 and No. 602 grinders run with a free speed of 4200 r.p.m. and are suitable for grinding, buffing or polishing work of a varied nature. Each machine has the same type of motor, but is equipped with a different throttle and handle. The No. 601 has the closed type of inside trigger handle, while the No. 602 is fitted with the rolling type of throttle handle. A special feature of these tools is the three cylinder motor (entirely different from that of the No. 8 drill, described above) which runs constantly in a bath of oil, insuring lubrication of all the parts. Lack of proper oiling has been one of the reasons for grinder troubles in the past. The valve is made integral with the crankshaft, simplifying the design, and the piston and connecting rods also are of special construction. Ball and roller bearings are used throughout. The removal of a few screws enables the handle to be lifted off and exposes the entire mechanism to view, making inspection of the parts easy.



Light Weight Pneumatic Drills

The No. 6 and No. 600 drills meet the demand for light air tools required to drill small holes without breaking the drills. They will handle twist drills from the smallest size up to ⅜ in. diameter. The free speed at 90 lb. air pressure is about 2000 r.p.m. The two machines differ essentially in the handle construction, the motors being the same. The No. 6 has the pistol grip type of handle, while No. 600 is furnished with breast plate and rolling throttle handle. Aluminum, reinforced with steel bushings, is used wherever pos-

sible and results in a lightweight machine; the No. 6 weighing only 9 lb. The motor is a three cylinder type somewhat similar to that used in the grinders mentioned above. The cylinders are separate iron castings, easily accessible, renewable and interchangeable. A sensitive throttle control has been obtained, which with freedom from vibration makes the tool well adapted for drilling with small drills. The bearings are all either of the ball or roller type.

Vortex Paint Spraying Equipment

PAINTING with mechanical appliances for industrial buildings, tanks, and other large equipment has been a recognized method long enough to win a firm contingent of supporters and also to array an equally firm support behind the older process of hand painting. That the hand painter holds on can only be regarded as proof

Vortex Painter in Use On Metal Building

that the problem of mechanical painting is more difficult than imagined by many of those who have offered various shapes and forms of spraying devices.

A few of the characteristic difficulties of paint spraying are (1) loss of paint, (2) scattering and splashing over surfaces not to be painted, (3) difficulty in the open air owing to wind interference, (4) pre-drying of the paint to a chalky consistency through evaporation of its volatile oils while in the air.

With these difficulties in mind, a paint spraying equipment has been perfected by the Vortex Manufacturing Company, Cleveland, Ohio, and placed on the market. The equipment includes a portable air compressor, paint tank and a nozzle. The Vortex nozzle has two openings, a central opening for paint and an annular opening around the center from which the air is discharged under a pressure approximating 60 lb. per sq. in. There are separate conduits for air and paint, terminating in a right angle on each side, which forms an axis for the nozzle and permits it to be operated at any desired angle.

The paint is driven from the central outlet under low velocity and is immediately picked up by the surrounding air jet and carried to the painted surface. The air jet is too powerful for the paint to penetrate and the loss from spattering is remarkably small, the whole tendency being to spread evenly rather than spatter.

It is claimed that the Vortex painter carries a greater volume of paint per minute, due to the fact that it is not finely sprayed but applied in a relatively heavy liquid jet; there is a better penetration of rough surfaces and a more efficient brushing action by the air jet which makes it possible to cover completely and smoothly with a single coat. Scaffolding can be very largely dispensed with by use of a 12-ft. arm, when desired. There is also the important advantage of having a powerful air jet for cleaning dirty surfaces and reaching crevices and out of the way corners.

Any fairly efficient jet system should have an advantage over brushing in the treatment of rough surfaces, such as rock faced masonry, rough lumber, etc., because perpendicular application of the paint is certain to penetrate voids better than brushing across the surface.

It is possible to paint 2,000 sq. ft. per hour or more on plain interior work with a Vortex painter where conditions are favorable and the operator experienced in his task. A striking demonstration of possibilities in outdoor work was the painting of a large storage tank on the roof of a building. This was given a single but sufficient protective coating of red in three and a half hours, although the tank had 3,500 sq. ft. of surface. It rose 18 ft. from the top of the tower on which it was located and no ladders or scaffolding were required.

Air Required to Operate Preheaters

THE following data are the result of recent tests made by the Metal & Thermit Corporation, New York, to determine the proper amount of air required for special thermit welding gasoline and compressed air preheaters. The practical minimum pressure for operating preheaters appears to be 25 lb. per sq. in. At this pressure a single burner preheater will require approximately 25 cu. ft. of free air per minute and a double burner preheater approximately 50 cu. ft. of free air per minute. For very large welds, where the walls of the molds are thick and the preheater gates longer than usual, a pressure of 40 lb. per sq. in. would be advisable, which would require approximately 35 cu. ft. of free air per minute for a single burner preheater and 70 cu. ft. of free air per minute for a double burner preheater.

In the case of large shops with a central air compressor plant, upon which demands are being made by many departments, the pressure quoted above should be maintained at the outlet to which the preheaters are attached. This is a very important point as, too often, the operator forgets that a considerable loss of pressure takes place in the pipe line.

Large Capacity Multiple Spindle Automatic

A MARKED advance in automatic screw machine design has been registered in the development of large capacity 3-in. and 4-in. multiple spindle automatic screw machines by the National-Acme Company, Cleveland, Ohio. These machines were evolved as a result of the demand for a larger unit of the National-Acme line, which previously only had a range up to 2¼ in. Two of these machines have been installed in a railroad shop and are very successfully working on side rod oil cups, ball joint rings for injector branch pipes, etc.

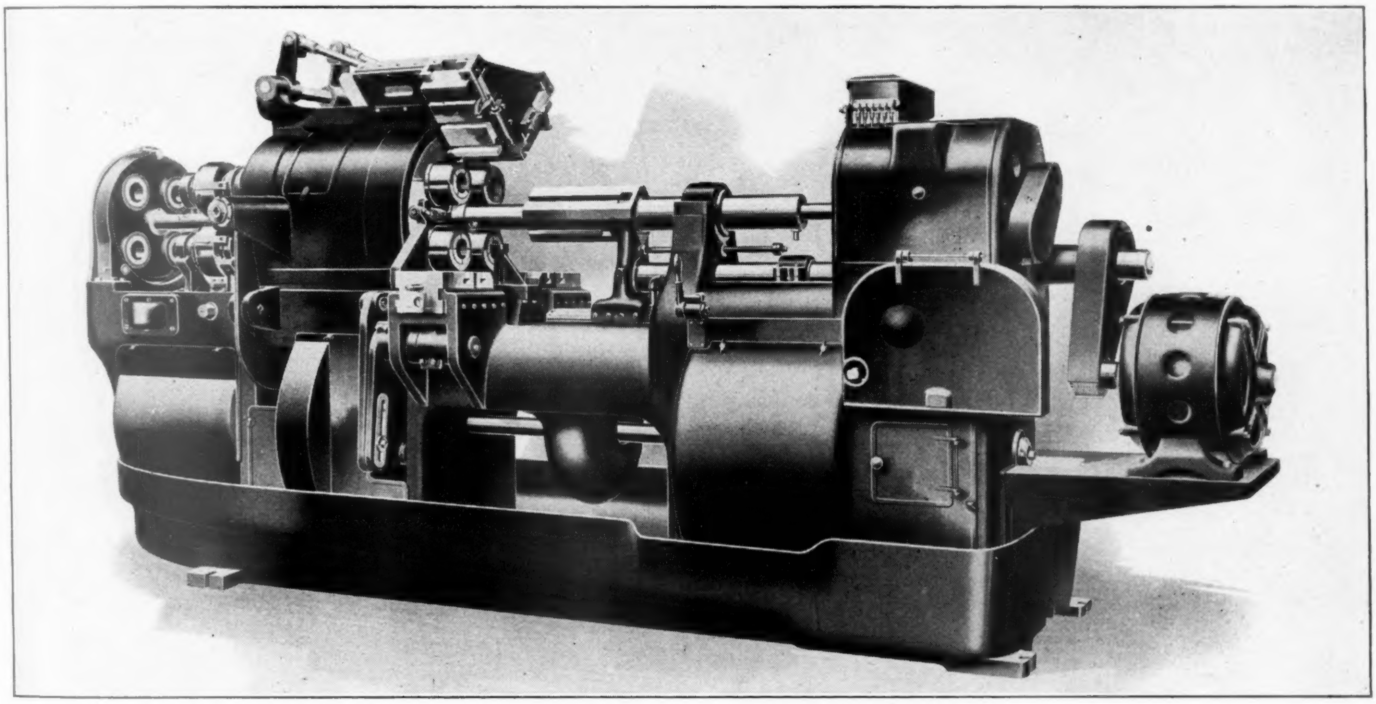
Many new features were incorporated, necessitated by the large capacity of the machines and to insure rigidity and accuracy under heavy cuts and feeds. Heavy and rigid design to cope with tough composition steels, maximum cutting feeds and speeds made possible by modern tool steel, precision and fast output were the goals. These combined with standardization of equipment, convenience in operation, safety devices, reduction in unit driving power and simplicity of design have been secured in this machine, still adhering to the principle of performing all screw machine operations in the time of the longest single cut. One notable departure has been made in the method of tooling, however, so that the 3-in. and 4-in. machines use right hand tools exclusively.

The design of the main tool slide or end tool turret provides the most rigid support for tools, as well as accessibility for setting up. It is a semi-steel casting in one piece, one end of which extends ahead of the four-faced turret proper and has its bearing in the center of the cylinder. The rear end is supported in a heavy bearing through an upright extension of the frame, which is cast integral with the bed itself. It is supported just back of the tools by an extension of the pusher rod which controls the feed of the tool carrier. This pusher is independent of the tool carrier proper, being connected to the carrier at the top by a pin, and at the bottom it travels on a wide-bearing plate mounted on the center of the frame. From the pusher rod is an extension with a roller for the lead cam. This extension is fastened to the pusher rod which is supported at a 45 degree angle with respect to the lead cam, and its movement is against a hardened steel plate screwed to the bed. The bearings receive no side thrust from the lead and take-back cams.

Because of this rigid system of supporting the tool carrier, side thrust is equalized so that heavy cuts and coarse feeds may be employed to the maximum capacity of the machine, and yet insure accuracy.

The stop-rod between the pusher and the carrier is the main stop for accurately regulating the length of the turret travel. This is controlled by nuts adjusted for different lead cams. Tool holders having wide bearings are fastened against four flat surfaces of the turret, and are supported directly underneath their cutting points with no overhang.

The forming and cut-off slide bearings are cast with the bed, and so designed as to support the forming tool its entire length, and directly underneath the cutting pressure. The connection between the forming and cut-off levers and their slides is through a 2½-in. hexagon shaft, assuring positive feed to the slides, without spring. The slides are adjusted vertically by taper gibs, and horizontally by straight gibs. The levers, controlling the feed of the cross slides, are provided with slots, making them easily adjustable and requiring only minimum change of cams for different feeds. With this adjustable arrangement, for forming and cut-off levers only three cams are required for all work within the capacity of the machines, two being ample for normal work and furnished with the machine.



Acme Multiple Spindle Automatic, 3-In. to 4-In. Capacity

A forming stop, consisting of a bracket mounted on the slide in connection with adjustable studs located between each of the four spindles, provides a separate adjustment for each, and is a further safeguard for uniformity of product.

To facilitate quick, accurate adjustment for the depth of cut for the forming and cut-off tools, screws are operated through the center of the slides independent of the tool holders.

The top slides are operated by two straight and interchangeable cams through rods and levers, arranged so that

both slides can be adjusted by manipulating one interchangeable cam on the main cam shaft. The lever shaft controlling the travel of both slides is hexagonal, thus obviating any chance of the loosening, common to key set shafts. The top slides accommodate the same holders and tools that are used on the forming and cut-off slides, and the method of adjusting the slides by gibs is the same.

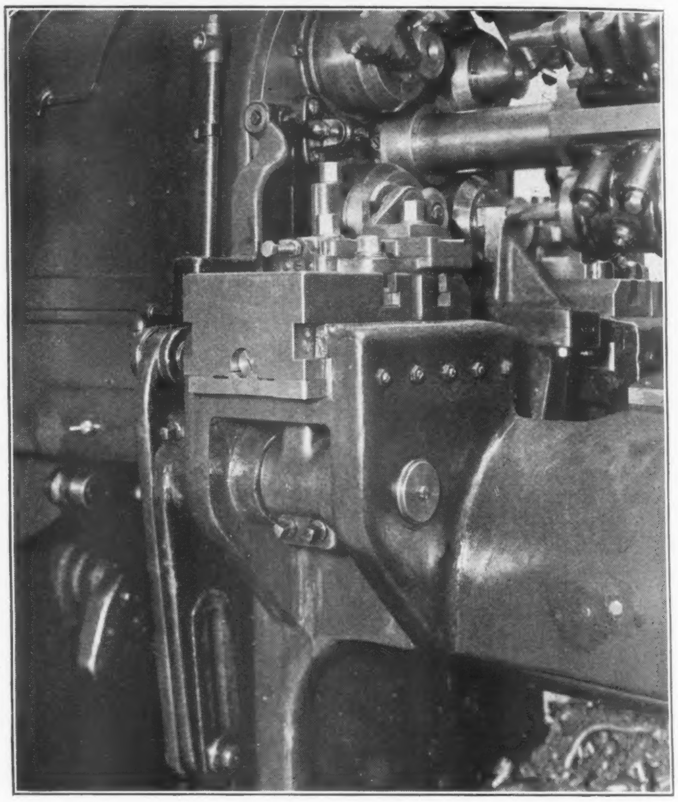
New features in the cylinder construction tend to minimize wear and provide easy adjustment. The cylinder casing has been made unusually strong, and in addition to being secured to the bed by heavy bolts, the casing is dovetailed to the bed. Two brass shoes are located independently on top of the cylinder casing for both front and rear bushings, and are adjusted by screws without any interference with the top slide. It should be borne in mind that this adjustment is made toward the center of the machine, the point of greatest strain.

Compensation for end wear is provided in a take-up located on the rear of the cylinder, secured by adjustable brass shoes on the reel cross support, and tightened to the cylinder. The cylinder does not depend upon its bearing against the adjustable shoe resisting the end thrust, because the front of the cylinder casing is counter-bored, thus giving the cylinder a bearing on its entire periphery.

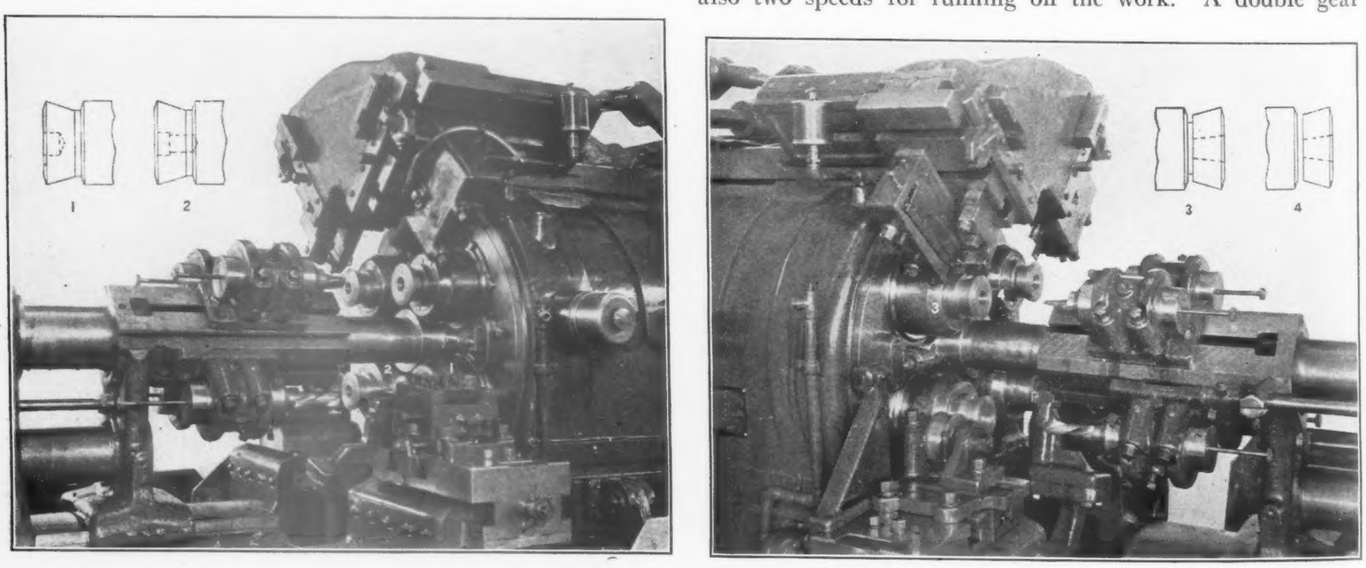
The front and rear spindle bearings are of the straight type, the material being a special bronze composition with end thrust bearings. Most important is the point that the spindles proper are not affected by wear, because a main bronze bearing is secured to the spindles and runs in a hardened steel bearing fitted to the cylinder. Moreover, the spindle gears are located centrally between the bearings instead of at the ends of the spindles; thus the pressure of the gears tends to equalize the action against the bearings on the spindle, at the same time affording rigid support by reason of the bearings being located further apart. The result of this new construction is easy rotative action, less power, higher cutting speed and easy replacement of both spindle and cylinder bearings when worn.

The drawback type of collet is used, the advantages of this collet as compared with the push type being five-fold: (1) they run true because they are drawn back in a taper which has been ground in the spindle itself; (2) the stock feeds more easily; (3) the collets hold more tightly under heavy end thrust, such as drilling or heavy turning; (4) there is no strain or spring at the stock stop, because in locking the stock, the bars draw back away from the stop instead of pushing against it; (5) the spindle bearings are protected when forming, because drawback chucks permit of a much shorter projection of the spindles from the cylinder.

While this machine is not fitted with the threading spindle, unless so ordered, provision is made for including it as a part of the standard equipment. The die spindle runs right-handed. It is operated independent of the travel of the main tool carrier and has two cutting speeds, either 1 : 3 or 1 : 5 in ratio to the revolutions of the work spindles, also two speeds for running off the work. A double gear is used—one mesh for one speed and another for a different travel. Spindle speeds are varied by shifting the double gears. Change from left-hand to right-hand threads is accomplished merely by reversing the cams operating the friction. When button dies or taps are the threading equip-



Forming and Cut Off Slide Showing Adjustable Lever



Tool Set-up and Operations in Forming a Gear Blank

ment, an extra holder is used; but for opening dies or collapsing taps, only the regular equipment is required.

The turnover of the stock-carrying cylinder is accomplished by the Geneva movement and is quick, positive and with minimum strain or wear. Locking of the cylinder in the four successive positions is secured by a lock bolt on the forming side of the cylinder and a latch bolt on the cut-off side. This arrangement has been found most practical, because the lock bolt naturally pulls the cylinder down, and with this system there is less competing pressure.

Positive operation of the lock bolt is controlled by a spring directly in connection with the bolt and by a cam and roller from the main cam shaft, thus securing a rigid locking when heavy or exceptionally long bars are used.

Stock may be fed in either the first or fourth spindle positions according to the class of work in hand. The slide controlling the stock feed is independent, having its bearing on two rods between the casing and the end of the machine. It is equipped with double levers connected by rollers, and one of these rollers is changed in two positions for the 6-in. and 12-in. feeds. Intermediate feeds are secured simply by adjusting the collar on the stock pusher rod.

The pan is of unusual size constructed with three strong ribs in the floor portion and the bed which is screwed to the pan is in one piece, except the cylinder casting, which is screwed and dovetailed on as explained above. All the main gears are steel, the levers are steel castings and the main tool carrier is semi-steel.

Ample clearance is provided for chip room by the open construction below the main tool turret. The oval form of the center bed allows the chips to be washed off quickly into the pan. The general operating mechanism, forming and cut-off are under the cylinder, thus separating the chips from the working parts.

All the tools on the main tool carrier are inside the circumference of the spindles, thereby allowing for tool construction of varied sizes and shapes without interfering with each other or with the center turret extension.

The bearings for the back gears, also for the worm drive, are connected with a single oil reservoir mounted over the gear box. The feed of oil is regulated individually by thumb screws at the bottom of the reservoir, and all the oil tubes have a main shut-off so that individual adjustments do not need to be disturbed when the machine is stopped. The main spindle bearings are provided with oil chambers supplied by gravity feed cups.

Safety and convenience of operation have been carefully considered and cared for in the design of this machine. All working parts, such as gears, cam drums and friction, are completely housed. A safety device is applied direct to the worm gear on the cam shaft as follows: Instead of keying the worm to the cam shaft, a disc is keyed on the shaft parallel to the worm gear and joined with shearing pins which are easily replaced when broken. This device prevents accident, due to irregular stock feeding, mis-alinement of feed tubes and errors in setting up the tools.

In addition to the provision made for cranking by hand from the forming side of the machine, an extension, from the worm shaft to an independent stud and through to the cut-off side of the machine, allows the operator to crank the machine from either side, thus conveniently observing the movement of the tools while setting up.

The starting clutch lever for throwing into automatic feed is also controlled from either side; and when thrown into automatic feed, the hand crank is automatically disengaged, thus avoiding any possibility of accident due to negligence.

The machines are furnished either belt or motor driven. When motor driven a 10-h.p. motor is required for the 3-inch machine and a 15-h.p. motor for the 4-inch machine. Top slides, threading attachment and an accelerated reaming and high speed drilling attachment are not standard equipment furnished with the machine.

Exceptionally Large Plate Bending Rolls

ONE of the largest plate-bending rolls built in the central states has just been purchased by the General American Tank Car Corporation of Joseph T. Ryerson & Son, Chicago. The machine is of exceptional size, and is provided throughout with steel gears and bronzed bushed bearings. In the past it has been the custom to build heavy machinery of this kind with cast gears and either babbitted bearings or bearings directly on cast iron. This machine measures 34 ft. 2 in. between housings and has a capacity for bending ¾-in. mild steel plates. The top roll is 29 in. in diameter and weighs about 40 tons. The bottom rolls are 21 in. in diameter and have two roller supports. The rolls are mounted on a rigid cast iron sub-base and have independent motors for main drive and power adjustment of the top roll.

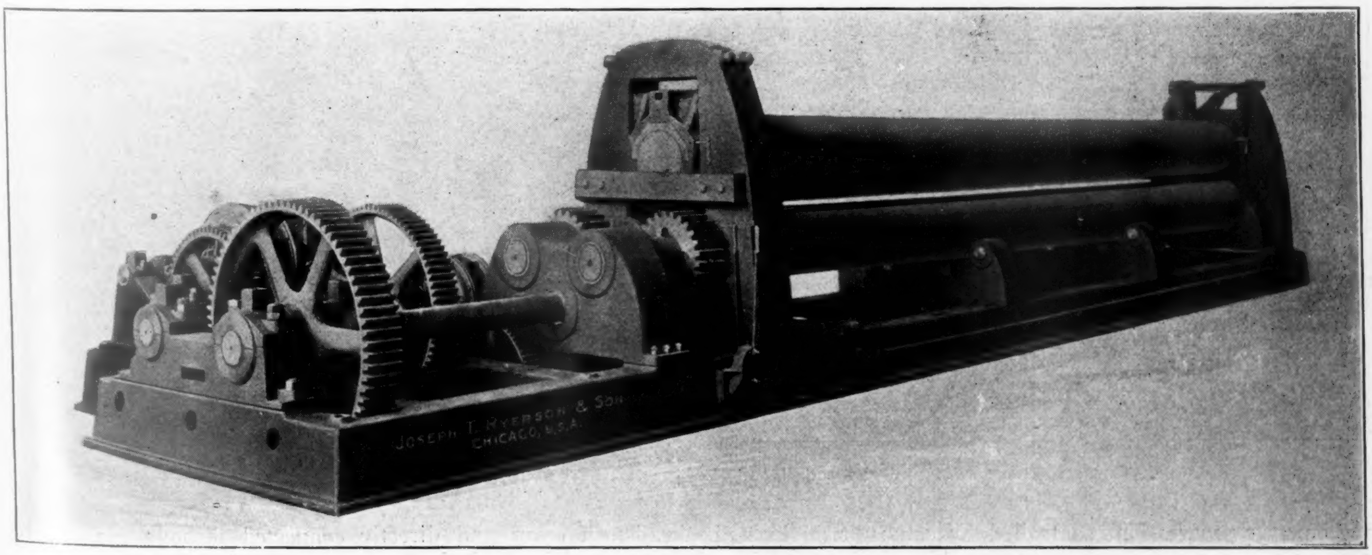


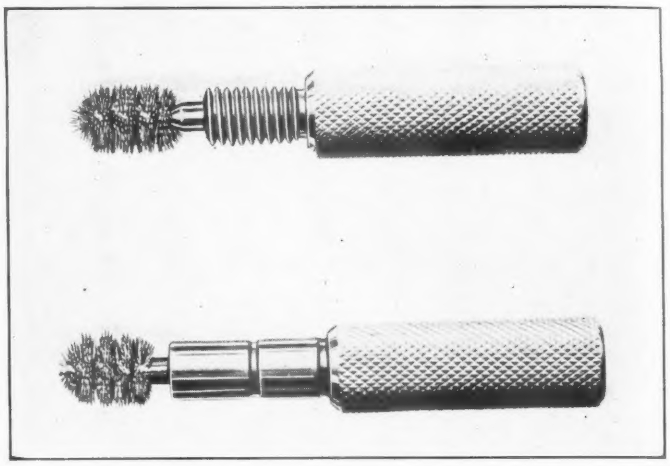
Plate Bending Rolls that measure 34-ft. 2-in. between Housings and can bend ¾-in. Mild Steel Plates.

Pilot Brush Increases Gage Life

IN order to provide a wider field for the use of plug and screw gages and to increase the life of many gages now used in manufacturing processes, a combination brush and gage has been developed and placed on the market by the Brush Pilot Gauge Company, Springfield, Mass. By the use of this combination brush and gage, more accurate testing is accomplished and the life of the gage is greatly increased because of the removal of dirt and foreign matter. The brush also acts as a pilot, thereby eliminating almost entirely the wear commonly occurring at the entrance end of the gage. More accurate testing is another advantage resulting from the elimination of end wear on the gage.

Cleaning the surface before the gage enters a test piece prevents abrasive action, and at the same time gives increased accuracy to measurements and increased speed to the inspection work. The spiral brushes are so made as to leave the bristles at slightly varying lengths and when used in conjunction with a screw gage, the bristles tend to thoroughly clean out the thread both at the top and the bottom. The illustration shows a brush applied to two common types of test gages.

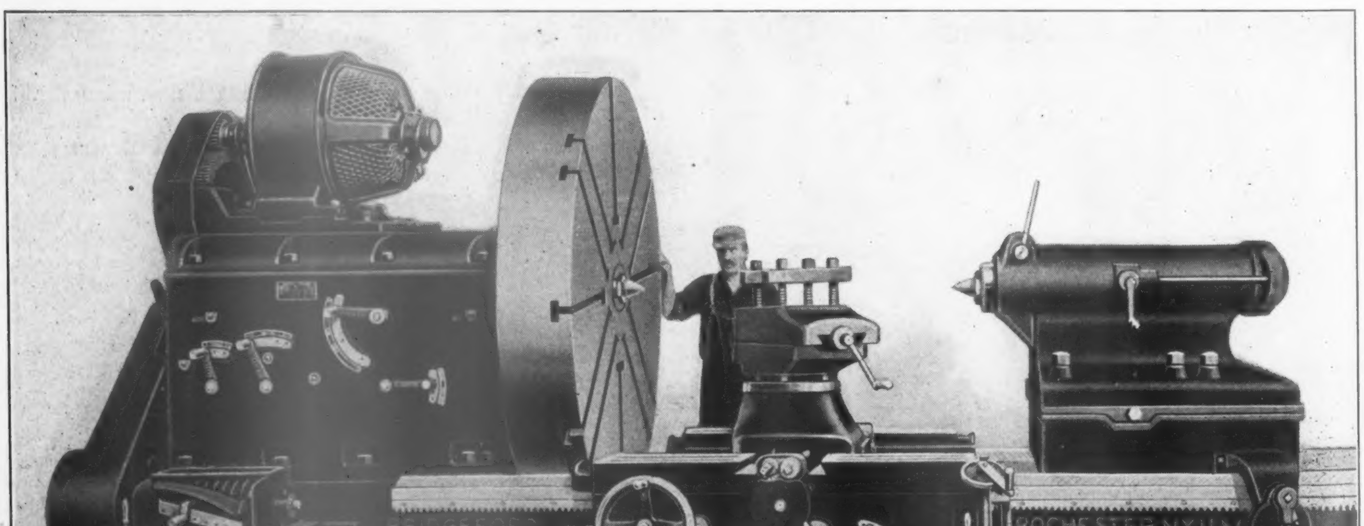
It is claimed that the pilot brush will increase the life of a test gage approximately three hundred per cent, resulting in an important saving to any manufacturing machine shop where the simplest kind of plug gage costs five dollars.



Pilot Brush Applied to Familiar Types of Test Gages

Powerful All-Geared Head Engine Lathe

A NEW, all-geared head engine lathe with a swing of 60 in. and 72 in. has been designed by the Betts Machine Company, Rochester, N. Y. The headstock is driven through a powerful expanding ring friction clutch which is operated from the apron, convenient to the operator. The same movement which disengages the clutch automatically applies the friction brake. There are 12 spindle speeds in geometric progression, controlled by conveniently located levers at the front of the headstock. All speeds are driven through an internal face plate gear and pinion.



Betts-Bridgeford All Geared Head Engine Lathe; 60-In. and 72-In. Swing

All speed changes are obtained through hardened steel sliding gears and positive clutches running in oil. The edges of the gear teeth are rounded to allow for instant and easy engagement and no two speeds can be engaged at the same time. Shafts and gears are located in the lower half or base of the headstock and not in the cover, thereby allowing easy access to all of the parts, it being necessary only to remove the cover. All shaft bearings are bronze bushed and all bearings are lubricated by means of chain oilers. When the machine is motor driven, the motor is mounted on top of the headstock cover and directly connected through gearing to the main driving shaft.

There are 32 changes of feed and lead obtainable through quadrant gearing and a quick change gear box to the lead screw. Feeds are driven from a spline in the lead screw to the rack on the bed through large all-steel gears. No two

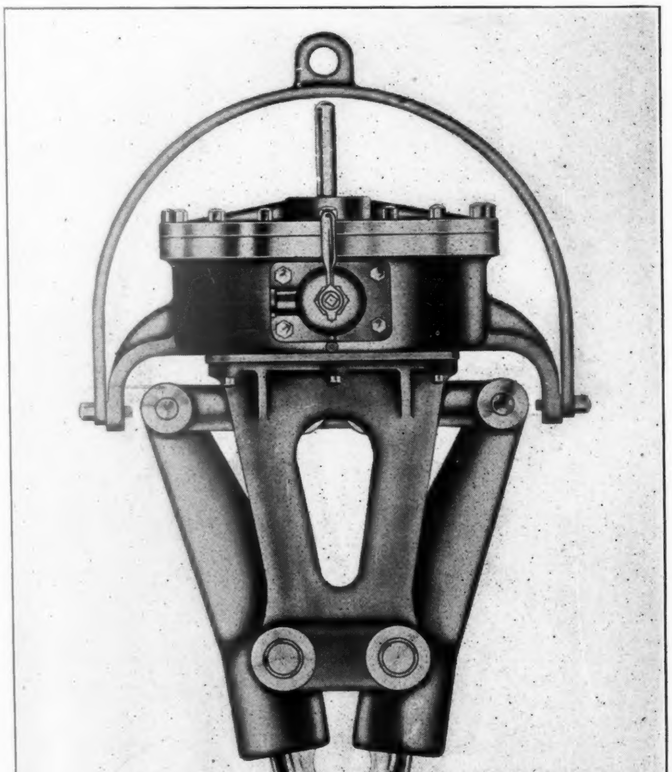
feeds can be engaged at the same time and feeds and leads are interlocking so that only one can be in use at one time.

All shafts in the apron have a bearing on each side, the apron being of double wall unit casting construction. The power angular feed to the compound rest is driven from the cross feed friction, a slip gear being provided for cross feeding or power angular feed. Both feeds and leads may also be reversed at the headstock. Power rapid traverse is obtained by means of a friction clutch on the lower shaft in the quick change box, which is driven from the constant speed headstock driving shaft by means of a Morse silent chain at the head end of the lathe. The rapid traverse is operated by a lever at the apron. The movement which engages the rapid traverse clutch automatically first disengages the feed and lead, making it impossible to have both engaged at the same time. Power angular feed is provided on the lathe.

Staybolt Cutter and Yoke Type Riveter

TWO pneumatic tools of particular interest are being introduced into railway shops by the Baird Pneumatic Tool Company, Kansas City, Mo. The staybolt cutter, illustrated, can be operated by one man and is used in clipping off staybolts up to 1⅛ in. in diameter at the rate of approximately 1,200 per hour. The machine is composed of a 15-in. air cylinder, the piston of which connects directly through a toggle joint with a pair of lever arms, into which the removable cutter knives are securely fastened. These knives are of sufficient strength to withstand the heavy pressure required in clipping staybolts. The working pressure is 100 lb.

A pressure of eighty tons is delivered to the cutter knives, which is sufficient to clip off staybolts up to 1⅛ in. in diameter. The cutter blades are so designed that, when placed against the sheet, the staybolt is cut off just the right distance from the sheet, to allow for heading over. This feature is



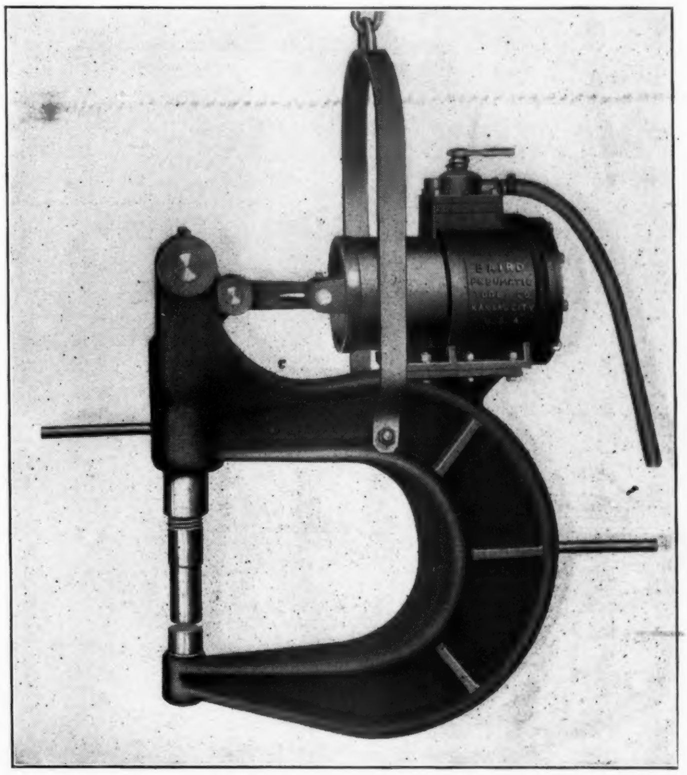
Baird Pneumatic Staybolt Cutter

a great time and labor saver and insures uniformity of work.

An additional advantage is the elimination of loose bolts caused by cutting them off with a hammer and chisel. The machine can be operated on modern radial stay boilers and is balanced to be held at any desired angle.

The length of the staybolt does not affect the operation of the machine. When long bolts are to be cut off a special pair of blades is used and the machine operates on an angle so that the bolts do not interfere. The machine is designed to be operated by one man and on account of its light construction and the convenient position of control valves, can be easily operated.

For the construction of truck frames, tank frames and locomotive boilers the yoke type riveter, illustrated, can be



Pneumatic Yoke Type Riveter

used to good advantage. The machine is equipped with a tandem cylinder having two pistons on a single rod. The necessary guide cylinder is utilized as a power cylinder and this arrangement doubles the power of a single cylinder. The stroke is short and the power is delivered with a quick direct blow. The construction obviates the necessity for large diameter cylinders of long stroke, or the double toggle or other arrangement.

The connecting rod of the riveter varies only one-half inch from a direct line from start to finish of the stroke. At the finish, when maximum power is desired, it is on a direct line. The toggle principle has the advantage of being small, compact and simple, with few bearings and little lost motion. The lever is an integral part of the lower toggle lever and develops its greatest power at the finish of the stroke. The adjusting screw is of the buttressed screw type, which has the advantage of a direct flat bearing surface, which reduces wear and lost motion to a minimum.

Because of the practical elimination of lost motion, rivets are driven rapidly with one blow before their heat is dissipated. A uniform set of each rivet therefore is obtained. Various sized cylinders can be furnished to deliver any desired tonnage to the dies. The control of tonnage delivered to the rivets can be regulated by an air line pressure valve to suit any class of work. This saves wear and tear on the machine and is economical in the use of air. Steam as well as compressed air can be used, although air is preferable. Suspension of the yoke type riveter is by a bale or link through the center of gravity, permitting operation from a horizontal or vertical position, or at any angle between. On larger sizes, foot brackets or rests are provided for installing the riveter in a stationary position by embedding in concrete. The operating handles for control valves on the standard equipment are placed on top of the cylinder.

Particular care has been given to eliminating exposed parts which might catch the clothing or person of the workman. The operation of the lever and toggle joint is such as to practically eliminate danger of personal injury.

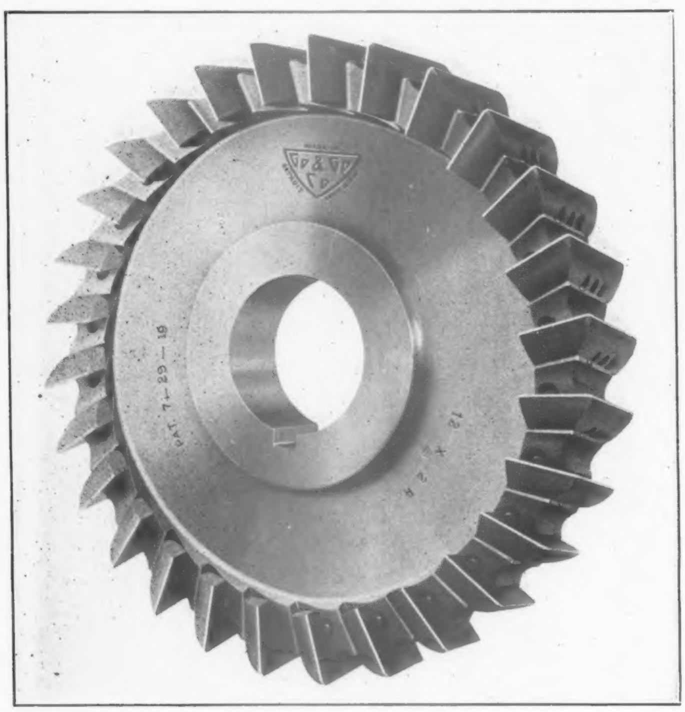
Two New High Speed Milling Cutters

BOTH solid and inserted blade milling cutters are now in common use, but improvements in design are made from time to time. Two recent developments in high speed steel cutters made by Goddard & Goddard Company, Detroit, Mich., are shown in the illustrations.

Inserted Tooth Mill

The inherent weakness in inserted blade cutters has generally been due to the fact that the blades were set radially in a soft steel body, the resulting radial cut consuming excessive power in removing metal; also, the severe use accorded these cutters often makes the soft steel body comparatively short lived.

In the inserted tooth mill, illustrated, maximum strength of tooth has been secured with maximum chip clearance. The blades are set at the same angle as in solid mills, giving a shearing action, which removes the maximum amount of metal with the minimum consumption of power. The body is made of alloy steel, heat treated to an elastic limit of approximately 105,000 lb. per sq. in., which, combined with extreme toughness, makes it able to withstand heavy feeds and speeds.

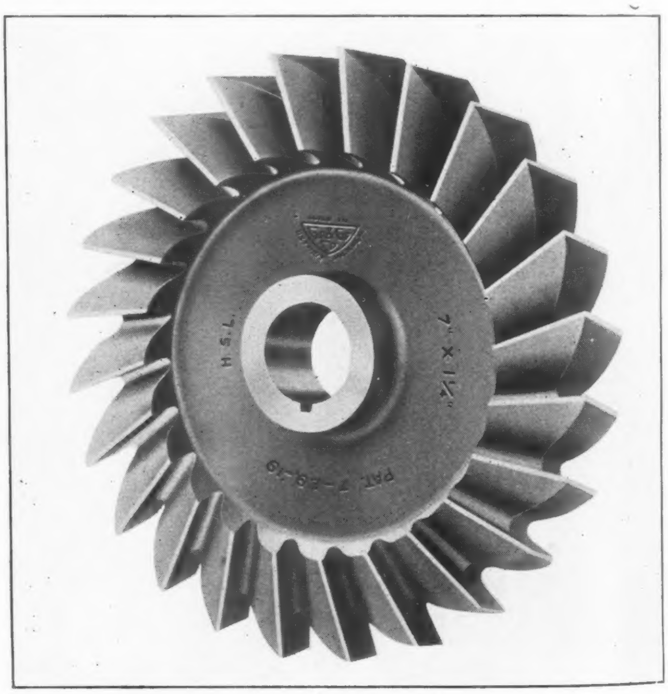


Goddard & Goddard Inserted Tooth Mill

The blades are held in the body by the well known wedge pin method, thus giving maximum strength to the tongue of body metal between the teeth. In addition, the blades are positioned positively against lateral thrust by dowel pins inserted in the periphery of the body. This arrangement also increases the life of the blades, as it will be noted that multiple notches allow three possible positions of the blades as they are ground down. The final setting of the blades maintains two-thirds of their length in the body of the cutter, thus giving adequate support. These cutters are made to be used in gangs, right and left, or bolted to a flanged spindle. They are recommended for work requiring cutters of 10 in. in diameter or larger.

Half Side Mill

The great volume of milling known as straddle work has usually been done by milling cutters provided with teeth on the periphery and both sides, the idea being that when the inside counter of each mill in a gang becomes dull the cutters can be transposed and a double amount of work done with a set of cutters at one grinding. The half side mill illustrated has teeth on the periphery and one side only. It will be noted, however, that the peripheral teeth are on a spiral, as well as being undercut. The following advantages of this arrangement may be mentioned: Spiral peripheral teeth, undercut on both the peripheral and side teeth, and a patented tooth form, which provides maximum tooth strength and chip clearance. These factors combined produce easy shearing action at the point of the tooth, where the service is most severe. In fact, each tooth is practically a diamond point and removes its share of metal with the



Half Side Mill With Deeply Cut Teeth

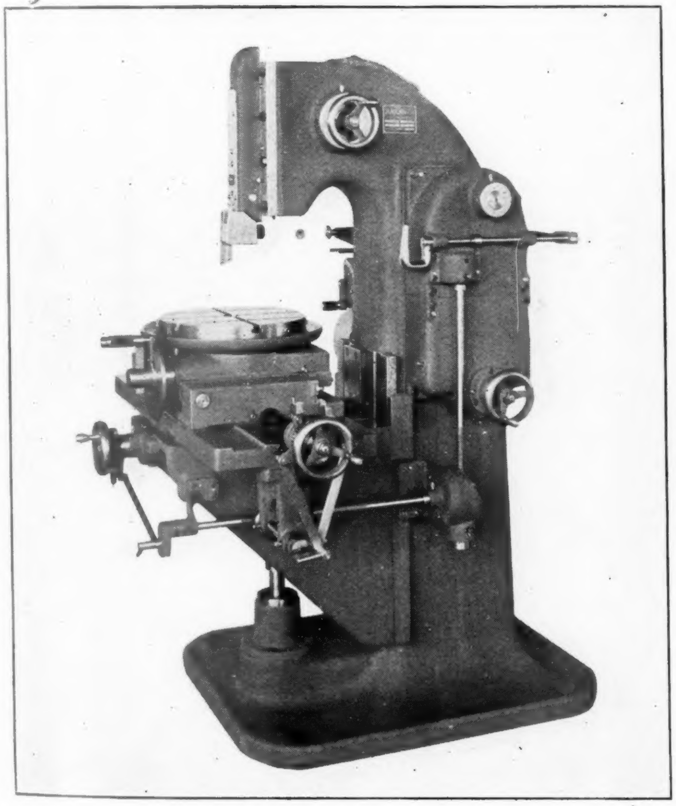
same ease, freedom and finish as a diamond point properly ground and set in the toolpost of a lathe. Further reference to the illustration of the half side mill shows the side teeth to be much deeper than ordinary. This feature allows more grinding and adds to the ultimate life of the cutter more than is possible with the ordinary side mill.

Goddard & Goddard half side mills are made in sizes varying from 4 in. to 9 in. in diameter. The center holes vary in size from 1¼ in. to 2 in., these relatively large sizes being necessary on account of the heavy work for which the cutters were designed. Both milling cutters described in this article are made of high speed steel only.

Vertical Shaper for Tool and Die Work

The manufacture of many tools, punches and dies for railway shop work involves certain machine operations that can be performed to good advantage on the vertical shaper illustrated. The machine is manufactured by the Hanson-Whitney Machine Company, Hartford, Conn., and especial care was taken to make it capable of rapid, accurate work. The ram travels rapidly and the entire shaper construction is rigid. Although of a comparatively small size, the machine has a large range and a large size die can be swung in all directions without interference. On the other hand, small tools for fine operations can be used.

In several respects the Hanson-Whitney vertical shaper differs from the type where a reciprocating ram is used for the action. Among other things the length of stroke can be adjusted whether the machine is running or still and with equal facility. This adjustment is made with the handwheel shown on the side of the column, near the top, the entire mechanism being of simple and durable construction.

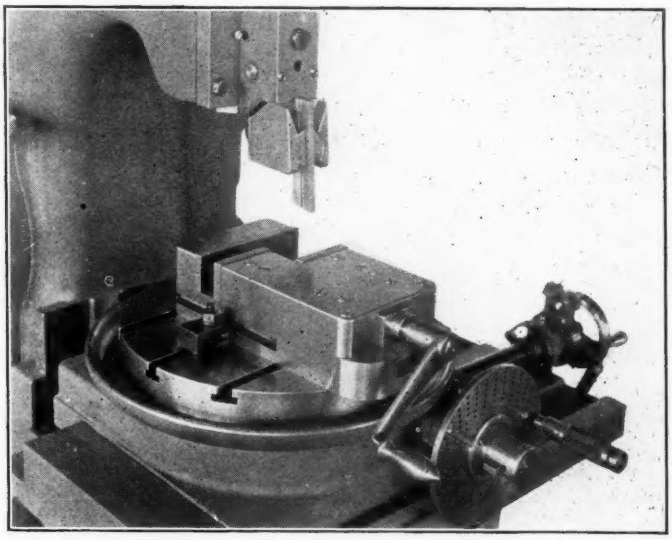


Hanson-Whitney Vertical Tool and Die Shaper

An elk horn shaped handle, shown on the right side of the column, controls the starting and stopping and when the machine is stopped, the ram will automatically stop on the end of the up stroke. This will occur no matter when the handle is placed in the stopping position.

Another advantage is that the tool on the back-stroke positively recedes from the work and on the down-stroke positively engages with it. Therefore, the edge of the tool does not drag on the work. Referring to the more detailed illustration, it is evident that no set screw or projecting obstacle on the tool holder prevents the ram from clearing the work. In other words, a long overhang of the tool is not necessary when planing the outside of a piece, and when planing the inside of a piece, such as a die, it is only necessary to have the overhang of the tool as long as the cut to be taken. The standard tool illustrated is made with a clearance and when sharpened needs to be ground only at the end. All working surfaces in connection with the clapper mechanism are made of hardened steel and ground.

Besides the rotary motion of the table, it can be tilted so that dies can be made with a clearance when desired. A segment, graduated in degrees, indicates the amount of taper that may be desired. The feed screws on the slides have micrometer dials graduated to .001 in. The machine is driven through a tight and loose pulley on the left hand side of the column and three speeds are provided. The fast driving pulley runs constantly, thus making it possible to drive the machine directly from the main shaft and eliminate a countershaft. An interlocking device prevents injury to the gears. The machine is controlled by the elk horn shaped handle, which operates an expanding friction clutch and drives the ram. About halfway down on the right side of the column there is a handwheel by means of which the machine can be turned by hand when setting up a piece of work, so as to make sure that there is no interference. As indicated, the knee is adjustable for positioning the stroke.



View Showing Details of Tool Post and Double Gap Vise

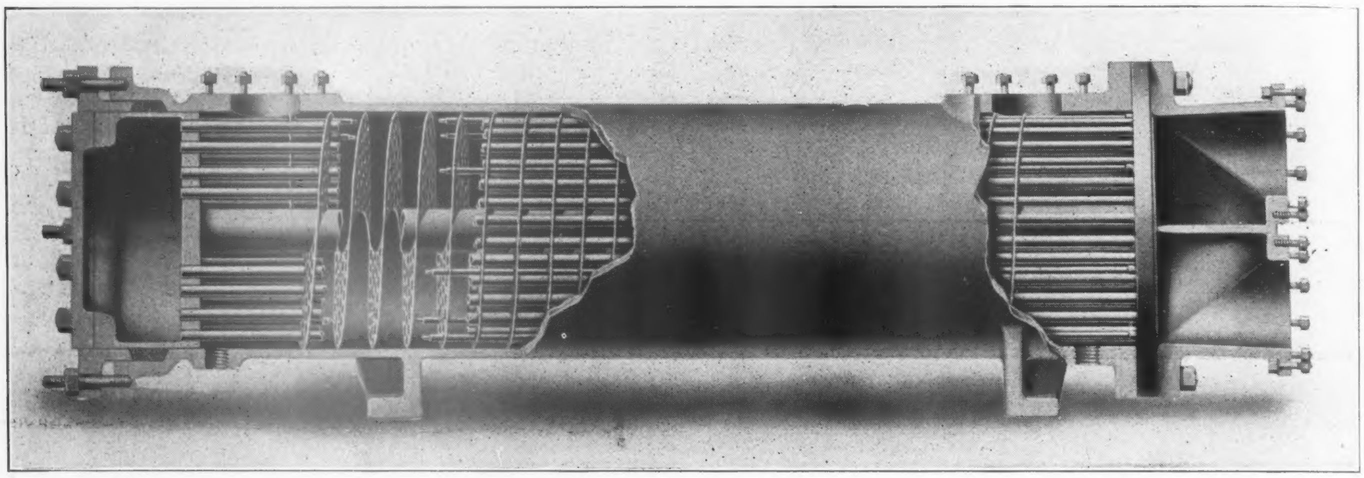
The stroke of the ram is 4¼ in. and the maximum difference from the table top to the end of the ram is 10½ in. The diameter of the rotary table is 14 in., the longitudinal and transverse travel being 15 in. and 8 in., respectively. The table can be tilted up to five degrees. The number of strokes per minute for each speed are 66, 114 and 200. The work vise, illustrated, is furnished only when ordered. It is made for holding small pieces and a 2-in. and 4-in. gap has proved a great convenience in setting up small jobs.

Cooler for Lubricating and Quenching Oils

AN ingenious device for the cooling of oil used in lubricating turbine bearings, or quenching oil in the heat treating of steel, has been developed by the Griscom-Russell Company, New York. Circulation through the cooler maintains the oil at a constant temperature and permits the continued use of the original quantity of oil and its maintenance at the proper viscosity for efficient results.

The apparatus takes its name from the whirling path of the oil, caused by the use of a helical baffle which directs the flow of oil without appreciably retarding its progress. This baffle also serves to bring the oil into intimate contact with the cooling surface and insures a high rate of heat transfer.

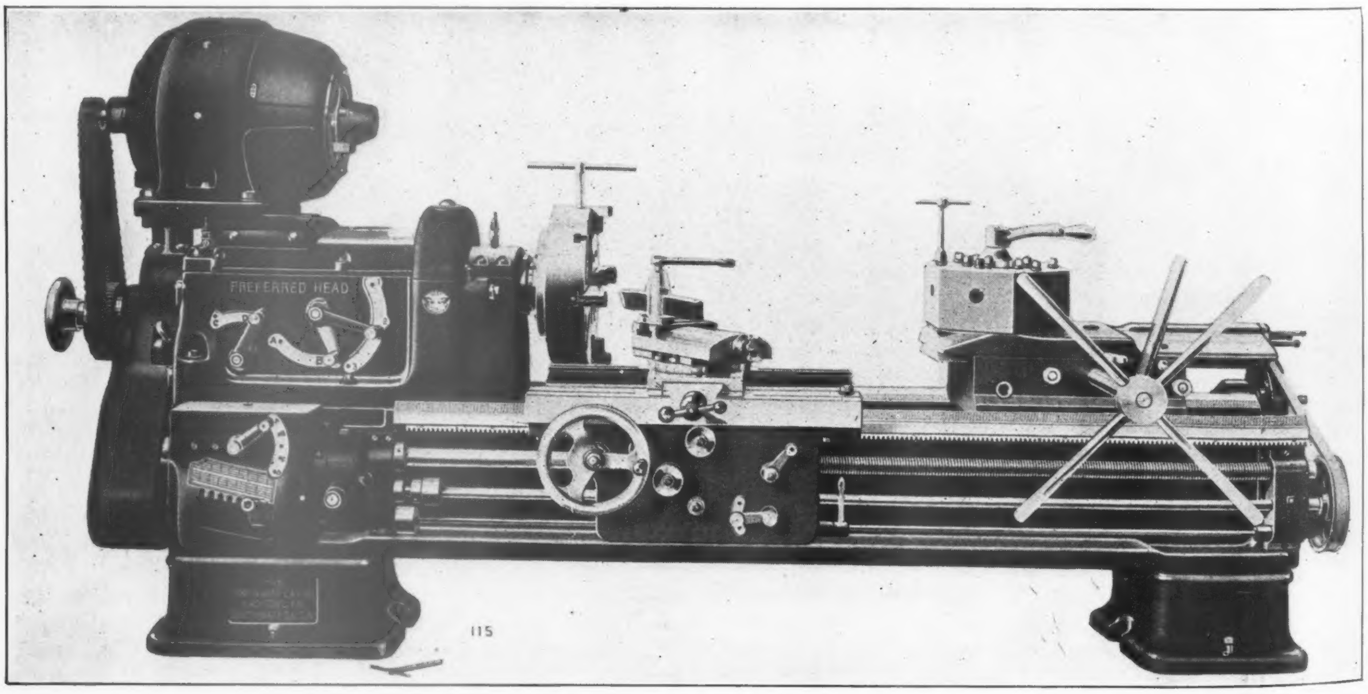
The shell is of cast iron and the tubes of seamless drawn brass or copper, expanded into a fixed tube plate at one end and into a floating head at the other. This permits expansion and contraction without strain on the tube joints. The cooling of quenching oil insures maintenance of the quenching bath at a fixed temperature and also permits the use of a cheaper grade of oil.



Griscom-Russell Multiwhirl Cooler

Cincinnati Geared Head Lathe

THE machine illustrated below is one of a line of geared head engine lathes manufactured by the Cincinnati Lathe & Tool Company, Cincinnati, Ohio, and previously described on page 174 of the March *Railway Mechanical Engineer*. These machines are now being made with three different types of drive, including belt drive from the main line shaft, motor drive with the motor mounted at the side or rear of the head and the arrangement illustrated, in which



Cincinnati Lathe Provided with Hexagon Turret and Driving Motor on the Headstock

the motor is mounted on the headstock. This arrangement takes up a minimum of floor space, but in case the motor would interfere with overhead jib cranes or traveling cranes, it may be placed either at the side or rear of the head and drive through a silent chain. The illustration shows the lathe equipped with a hexagon turret.

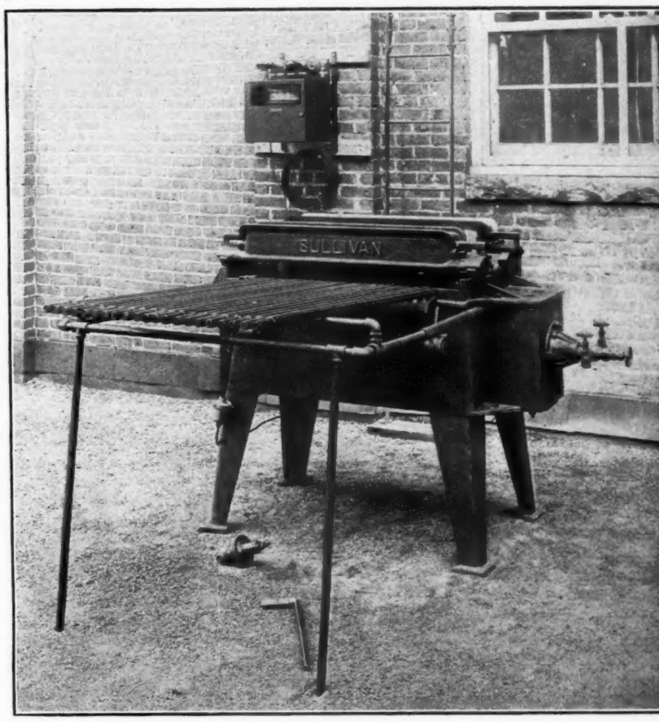
An Adaptable Drill Steel Furnace

WHILE the drill steel furnace illustrated was designed by the Sullivan Machinery Company, Chicago., Ill., especially for the efficient sharpening and tempering of drill steel used in mines and quarries, the field of usefulness of the furnace is not limited. Due to its general convenience and adaptability, it is suited for certain other heating purposes such as heating bars, bolts, rods, or coupling pins in railway shops.

In construction, the furnace consists of a rectangular cast iron box with a lining of firebrick having adjustable hearths and hoods, a burner or atomizer being attached at one end. The furnace is set at a convenient working height and an adjustable support carries the outer ends of the work. When it is desired to maintain a constant known temperature as in the hardening of steel, a pyrometer is used. A convenient arrangement of the pyrometer is shown in the illustration with the meter attached to the back wall.

Among the advantages of the Sullivan furnace may be mentioned the possibility of obtaining uniform temperatures without danger of overheating, large capacity, economy of fuel and compressed air, adaptability to different kinds of fuel such as oil or gas, flexibilty providing for adjustment to heat any portion of the work desired, ease of adjustment and repair, and low cost of maintenance.

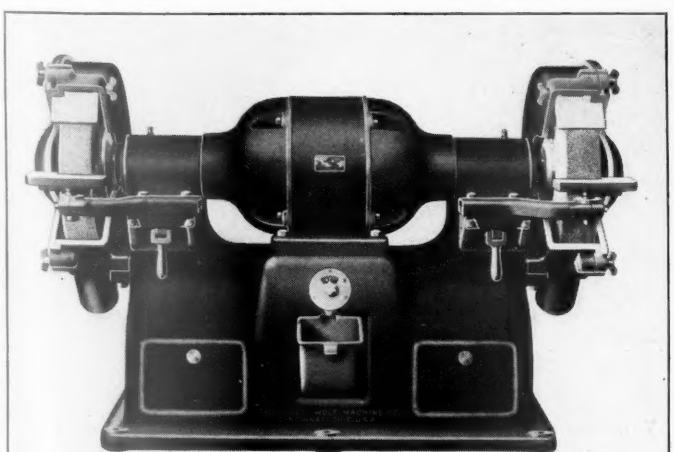
In operation, combustion takes place over the entire length of the combustion chamber of the furnace. The so-called cold end is that next the burner and the hot or finishing end is that farthest from the burner. With the furnace operating properly, an even flame is produced, a small portion of which comes up through the opening in the combustion chamber between the hearths at the hot end. The greater portion of this flame, however, is confined in the combustion chamber and produces a uniform reflected heat on the work.



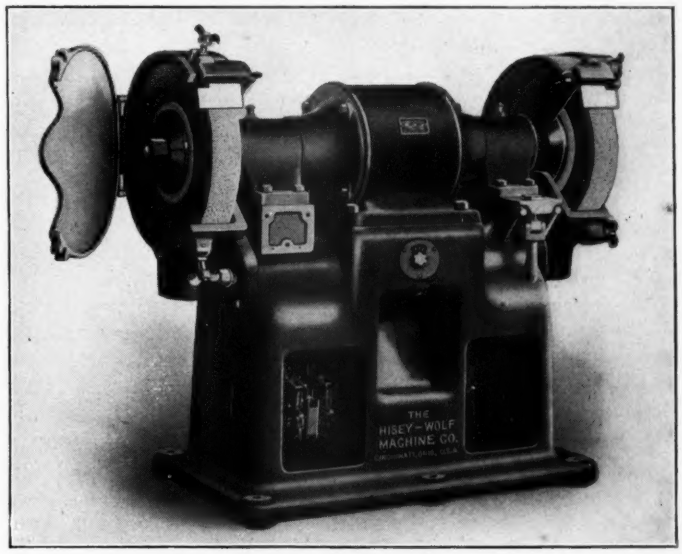
Sullivan Furnace and Pyrometer Installation

Self-Contained Motor-Driven Grinder

A NEW ball bearing grinding machine, driven by a self-contained 10-hp. motor, has been placed on the market by the Hisey-Wolf Machine Company, Cincinnati, Ohio. This machine, shown in the illustration, is designed to use two 24-in. grinding wheels, 4 in. wide. Friction



Hisey-Wolf Ball Bearing Grinding Machine



View Showing Quick Acting Switch and Adjustable Steel Guards

losses are reduced to a minimum by the use of SKF ball bearings mounted in the motor end caps, in close proximity to the grinding wheels. The construction of the bearing housing is such as to permit correct mounting from the exterior of the motor, a feature which increases the efficiency of the bearings and holds the armature spindle per-

manently in correct alinement. The importance of this feature can hardly be overestimated.

The generous and rugged proportions of the machine reduce vibration to a minimum and enable it to stand up under heavy duty and produce a uniform finish on all work ground. Not only is the friction loss in the grinder reduced to a minimum, but it is claimed that a grinding wheel lasts longer because, after once being balanced, it does not require frequent dressing.

Each machine is fitted with a quick acting switch, as shown in the detailed illustration and the larger sizes of grinder have an automatic starter equipment. The operating handle is located as shown in front of the motor, with the switch proper completely enclosed in the bed. This method of mounting insures protection and also permits ready access to all the switch mechanism by simply removing the cover plate.

Special attention is called to the wheel guards, which are made of steel to insure all possible protection. These guards enclose the grinding wheels for three-quarters of the circumference, are adjustable, and are so designed that the wheels can be removed independently. The water pot and pool tray are separate detachable units.

Arrangement can be made for either direct current or alternating current motor drive and in either case the motor is especially designed for the particular machine on which it is used. The Hisey-Wolf grinding machines are made in six sizes from ½ hp. to 10 hp. capacity.

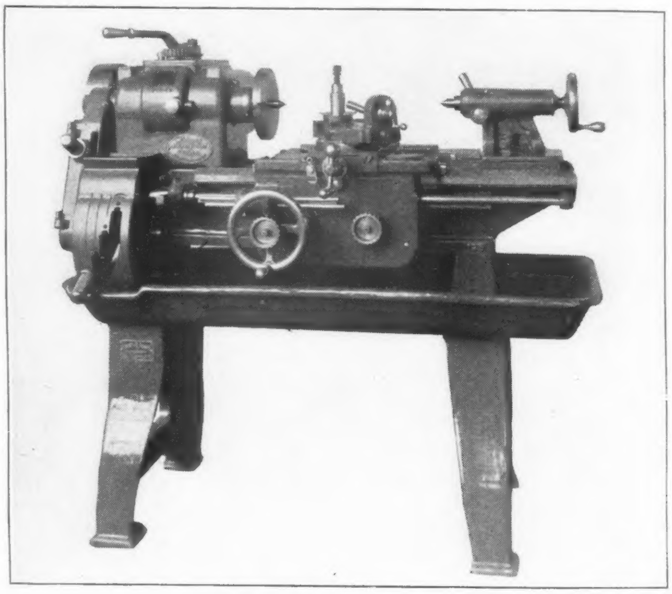
Short-Cut Lathe of Improved Design

A SHORT-CUT lathe with several important improvements not incorporated in the original machine has been placed on the market by the O. R. Adams Manufacturing Company, Rochester, N. Y. The lathe swings 13⅝ in. and is designed to take 20 in. between centers. It has a single pulley drive through a geared head and six changes of speed are obtained through an operating lever and knob. The operating lever provides two changes, the lever being placed so that the lathe can be started and stopped without making it necessary for the operator to move from his position in front. The neutral position of the lever applies a brake to all revolving parts, bringing the spindle to rest immediately.

All gears in the head run in a bath of oil and are of steel with the exception of the large gear on the spindle. The spindle itself is made from a special grade of alloy steel, ground accurately to size. It runs in phosphor bronze bearings which are adjustable and has an SKF self-alining ball bearing to take up the end thrust.

The carriage feeds are eight in number, obtained through a gear box with a tumbler gear, which provides four changes of feed. These vary from .006 to .025 with end gears in one ratio and a further range of feeds from .010 to .042 when the end gears are reversed. The carriage has power cross feed and the rate is indicated on the index plate mounted over the gear box. The direction of feed can be changed through a reverse lever mounted in a supplementary gear case at the headstock end of the lathe. All operating handles are conveniently located.

The carriage has a compound rest so arranged that it can be changed to either a four sided turret toolpost, combined front and rear tool rest or plain rest, without any additional fitting. The apron is of the double plate type with the two halves in contact, thus forming a box section of strength and



Adams Short-Cut Lathe

rigidity. Each lathe is supplied with an oil pan bed of sufficient size to prevent any cutting compound getting on the floor.

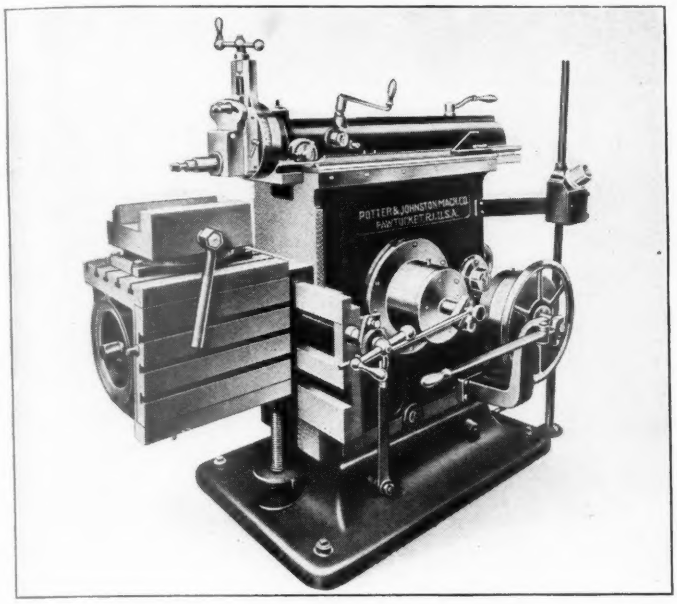
Universal Shaper With Unit Gear Box

THE 24-in. universal shaping machine described in this article is made by the Potter & Johnston Machine Company, Pawtucket, R. I., and particular attention is called to the gear box, which is a unit within the base of the machine. All the universal features necessary for die and tool work have been incorporated in the machine, which is at the same time well adapted for general manufacturing purposes or repair shop service. All control handles are on the right hand side of the shaper.

A heavy column, of correct design to withstand all ordinary strains, is securely fastened to the base of the machine. The total length of the base is 34 in. A large gear gives reciprocating motion to the ram by means of a wrist pin carried in a disk set eccentric in the gear. A graduated dial on the outside of the machine provides for adjustment to give different lengths of stroke. The ram is held securely down to its seating by means of rectangular straps on top of the column. A rectangular gib on one side of the ram provides for taking up wear.

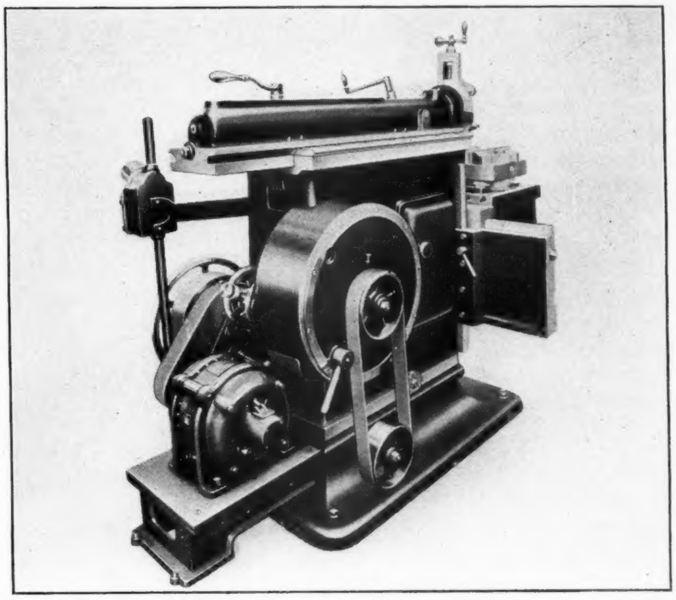
Power down feed for the tool head is operated by the movement of the ram against an adjustable feed cam dog, located along the side of the ram. This cam is capable of adjustment while the ram is in motion to obtain practical variations in the amount of feed. An adjustable stop at the side of the ram positively controls the down feed of the tool slide to any predetermined point. The table can be swiveled around a central pivot and is revolved by means of a worm carried in the table and engaging in teeth cut in the periphery of the pivot. One side of the table has an auxiliary tilting portion for obtaining compound angles. The

cross slide is exceptionally deep and accurately scraped to its bearing against the column. The table and cross slide are elevated and lowered by means of a power operated screw. The weight of these parts is carried on a ball bearing surrounding the elevating screw.



Potter & Johnston Universal Shaper

The gear box provided with the shaper is a unit with the base. Five speeds are obtainable by a movement of the shipper lever, which is located conveniently for the operator. The machine can be supplied with either motor drive or single pulley drive. When motor drive is desired, a 5-hp. constant speed motor is recommended, the drive being through a silent chain.



Rear View Showing Motor Drive

Snap Thread Gages for Accurate Inspection

A SNAP thread gage for accurate inspection of numerous threaded parts has been developed by the Herrmann Gauge Company, Detroit, Mich. This gage is shown in Fig. 1, which also indicates the adjustable jaws. For many purposes the snap thread gage has important advantages over the plug type thread gage. Its use eliminates the necessity of catching the thread and screwing the work into the gage and with the snap gage, all of this time is saved. In operation, it is used like the snap gage on cylindrical work. Since the work is not screwed into the gage, wear does not take place as usual, and it has been found that the size is maintained indefintely. The blades are made of hardened steel and will last a long time.

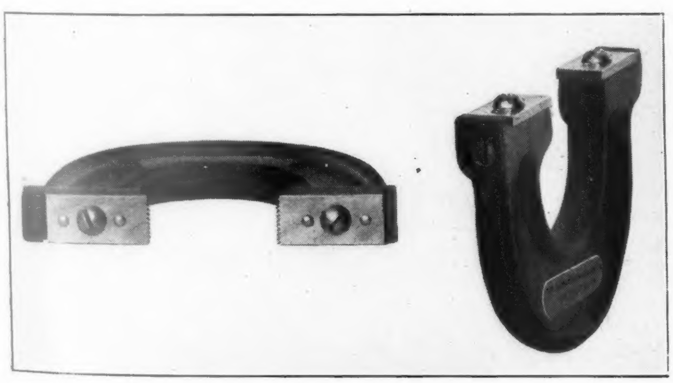


Fig. 1—Herrmann Snap Thread Gage

Because the parts are simple, the working surfaces can be accurately cut and lapped to any desired shape. Both jaws are made adjustable, as indicated in the illustration, and can be sealed to prevent a change in the setting. These snap thread gages are made in sizes from ¼ in. to 3 in. and with a variation of pitch from 8 to 27.

The snap gage designed for use as a limit gage is shown in Fig. 2. This tool can be used to good advantage in testing threaded work where it is desired to maintain the accuracy within two set limits. The limit gage is made in the same sizes as the snap thread gage.

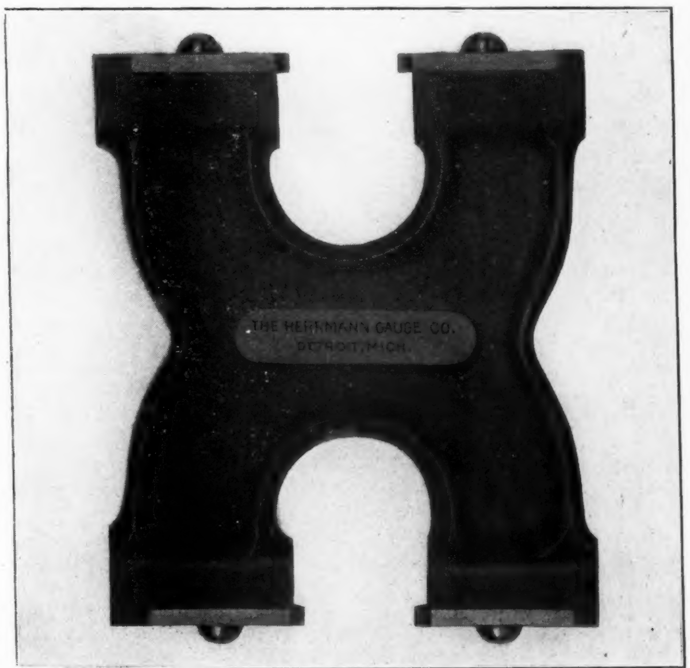
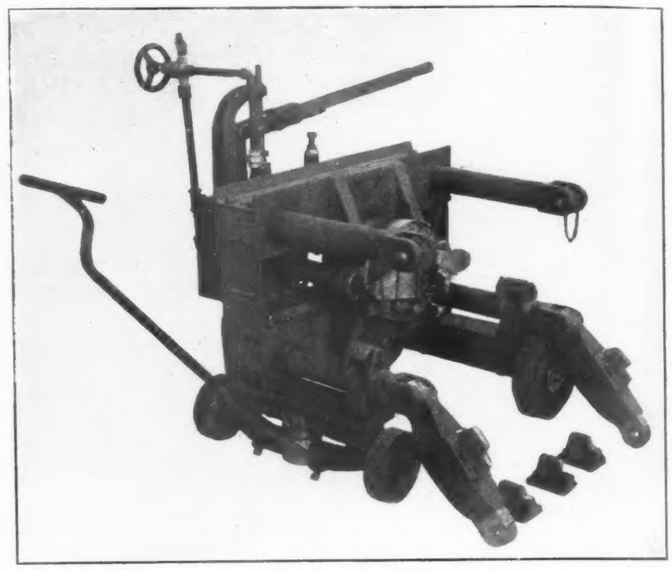


Fig. 2—Limit Snap Thread Gage

Hydraulic Rail Bender of 35 Tons Capacity

THE hydraulic rail-bending press illustrated was designed and built recently by the Hydraulic Press Manufacturing Company, Mt. Gilead, Ohio. As indicated, the press is of the horizontal type on wheels, and can be moved readily to any desired point. The capacity is 35 tons pressure. While of comparatively light construction, the press is rigid and of ample strength for the severest kind of service likely to be required of it. Four cast steel strain rods are rigidly attached to the double I-beams, the latter being formed like clevises at their outer ends. Steel hinge pins at the bottom and steel locking pins at the top pair of strain rods provide for connecting the two steel resistance heads when bending a rail. Each of the bottom strain rods has a steel roller mounted in such a way that when a rail is in the press it may be moved easily, in order to apply the pressure at different points.

The press is fitted with a class DD hand pump, spring safety release valve and a T-screw operating valve. The pump may be used for either high or low pressure. The low pressure may be used until the bending block meets the rail and the operator cannot work the pump, then the high pressure is used. The T-valve is closed when the pressure is applied and opened when the pressure is to be released. The spring pull-back device, which is enclosed in the two small sized cylinders, returns the ram to its initial position. In case a gage should be desired on the pipe line, it may be attached at the upper connection of the T-screw valve.



Portable Hydraulic Rail Bender of Improved Design.

Potter & Johnston Vertical Type Automatic

IN addition to a horizontal automatic, the Potter & Johnston Machine Company, Pawtucket, R. I., has placed on the market a vertical type of automatic chucking and turning machine designed to meet the demands of manufacturers having limited floor space. On all machines there are five combinations of three automatic variations of speed, giving fifteen spindle speeds in geometric progression from 14.3 r.p.m. to 140 r.p.m.

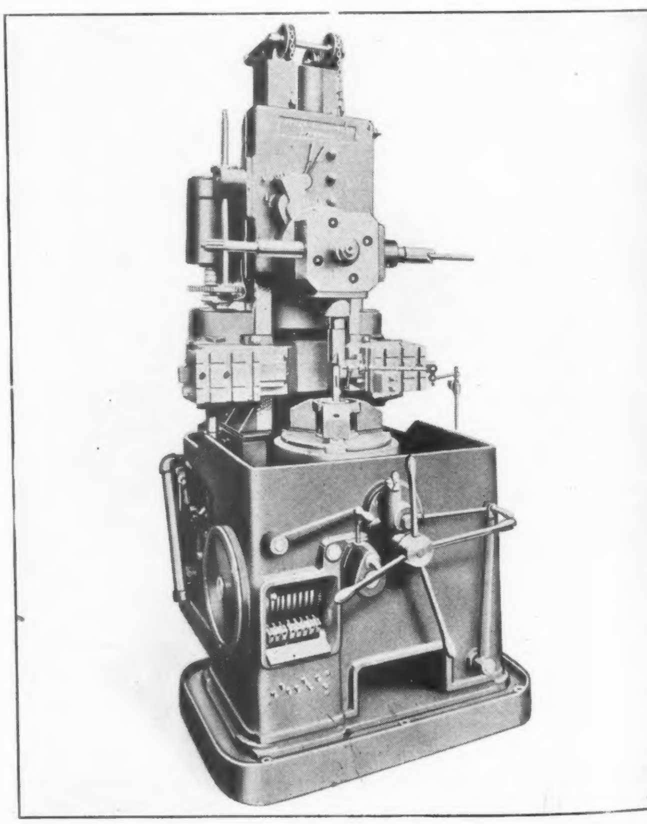
There are nine combinations of two automatic variations of feed giving eighteen feeds from .005 to .066 in. per revolution, and a threading and reaming feed from .050 to .125 in. per revolution, which allows the cutting of threads from 8 to 20 per in. The feeds are independent of the high constant speed for idle movements of the turret slide, while withdrawing and advancing the tools to the point of cutting.

The cross slide has a feed of 5 in. each way. The right and left hand side of the cross slide operate independently by screw feed, and can be arranged to feed into the work at any predetermined time, and at any desired relation one to the other.

The turret slide is of rugged construction and travels on ways so designed that all wear will be even and will not affect the accuracy of the machine. The turret slide has 14 in. feed and no allowance needs to be made for revolving as the turret revolves at the extreme end of its travel.

A 16-in. three-jaw scroll chuck is regularly furnished with each machine. This chuck is provided with a pilot bushing to receive pilot bars for supporting the tools during the cutting operations. The chuck jaws are operated by a pilot wheel at the front of the machine, which has been designed so that while the operator is using the pilot wheel it is impossible to throw in the feed, thereby eliminating danger of accident. The oil pump and piping and oiling arrangement through the turret are furnished on machines handling material requiring a lubricant.

As the machine is equipped with a single pulley drive, the motor application is simple. The motor is mounted on the upright at the rear of the machine, and the connection is by belt to the driving pulley. A 7½ hp., constant speed motor is recommended, and through change gears the same variation of speeds and feeds are obtainable as on the belt-driven machine.



Potter & Johnston Vertical Automatic Chucking and Turning Machine

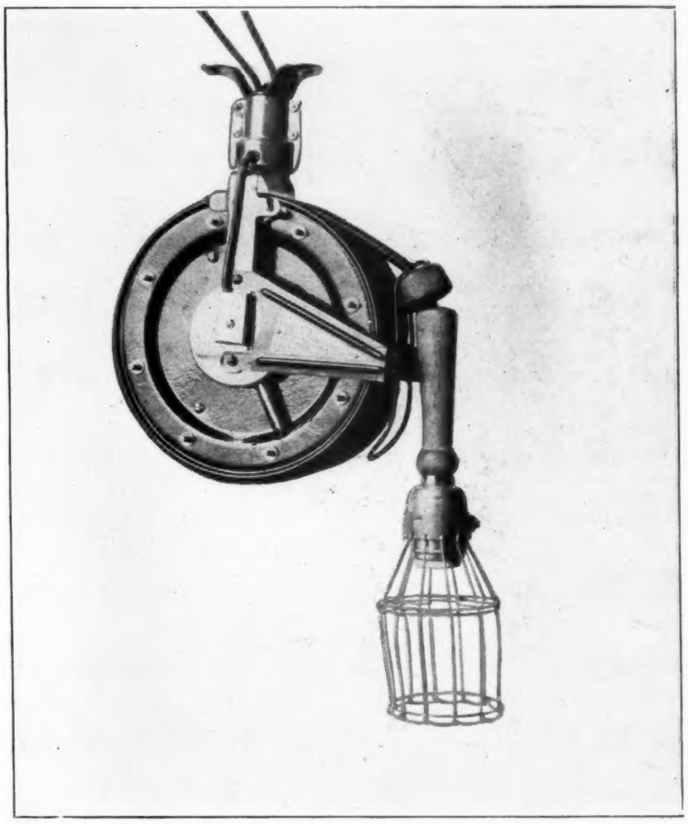
The Potter & Johnston vertical automatic has a swing over the ways of 23 in. and over the cross slide of 16 in. The turret has four faces. The holes in the turret are 2½ in. in diameter by 4½ in. deep. The distance from the center of the turret to the top of the turret slide is 4½ in., the maximum travel of the turret slide being 14 in. The turret feed is 14 in. and the turret slide adjustment 8 in. The length of turret slide travel, which permits of supporting or piloting tools, is 14 in. A minimum amount of space is required for this machine, due to the fact that the maximum width and length of bed are only 40 in. and 59 in., respectively. The total height of the machine is 8 ft. above the floor.

General Purpose Automatic Extension Reel

AMONG other uses, the automatic extension reel illustrated has proved of value in increasing the life of insulated electric cord used as extensions for portable drills, grinders and fans, as well as electric lights. Any one familiar with railway shops and especially railway shop tool rooms where the electric light cords are received after each day's work, will remember the frayed and worn appearance of many cords. Under the severe use accorded them, which includes pulling over the erecting shop floors and rolling trucks over them, the life of electric light cords is often short.

Not only do the ordinary extension cords have a relatively short life, but it is necessary to maintain an extra large number in stock due to the fact that in railway shops, forehanded mechanics anticipate the occasional need to light a dark corner by keeping extension cords and lights in their boxes. This condition can be remedied by installing an automatic reel permanently in the dark corner referred to.

Among the advantages of the automatic extension reel may be mentioned: longer life for the cord, light, fuses and guards; less danger of fire due to short circuits; and more convenience in operation due to the slack cord being rolled up at all times.



Autex Automatic Extension Reel

The reel is of simple, durable construction, and its actual size is 9 in. in diameter by 2 in. wide. It is equipped with 25 ft. of reinforced weatherproof cord. The head is provided with a swivel joint, enabling the lamp to be carried in any direction from the reel, while an automatic lock permits a positive stop at any desired point. It is insulated to withstand a test of 1,250 volts. In operation, the light or motor is taken in the operator's hand and carried to the desired distance, when a slow motion backwards causes the automatic lock to catch and hold the cord at that point. To release, a slight pull is given on the cord. This unlocks the catch and the cord is automatically rewound as the operator walks towards the reel, with lamp or motor in hand. The device is manufactured by the Cincinnati Specialty Manufacturing Company, Inc., Cincinnati, Ohio.

Independent Pneumatic Motor Hoists

PNEUMATIC motor hoists of one-half, one and two tons capacity have been placed on the market by the Independent Pneumatic Tool Company, Chicago, Ill. These hoists are made with two different lifts as follows: ½-ton and 1-ton hoists, 20 and 40 ft.; 2-ton hoist, 20 and 10 ft. The speed of lift for the ½-ton, 1-ton and 2-ton hoists is 32, 16 and 8 ft. per min., respectively, and the air consumption is 1.9, 3.8 and 7.6 cu. ft. per foot lift, respectively.

Equipped with a large worm gear drive, the worm is cut to a pitch that locks the drum and holds the load at any required point, even when the air is turned off, or the air line breaks. If necessary, the motor can be taken out for repairs while the load is suspended. An automatic stop prevents injury to the load or hoist by shutting off the air just before the cable is fully wound or unwound. The automatic stop can be adjusted or set for any lift, long or short, within the capacity of the hoist. The drum cover contains a permanent eyelet for the temporary cable used in placing the hoist in position, thus leaving the hook free for permanent attachment.

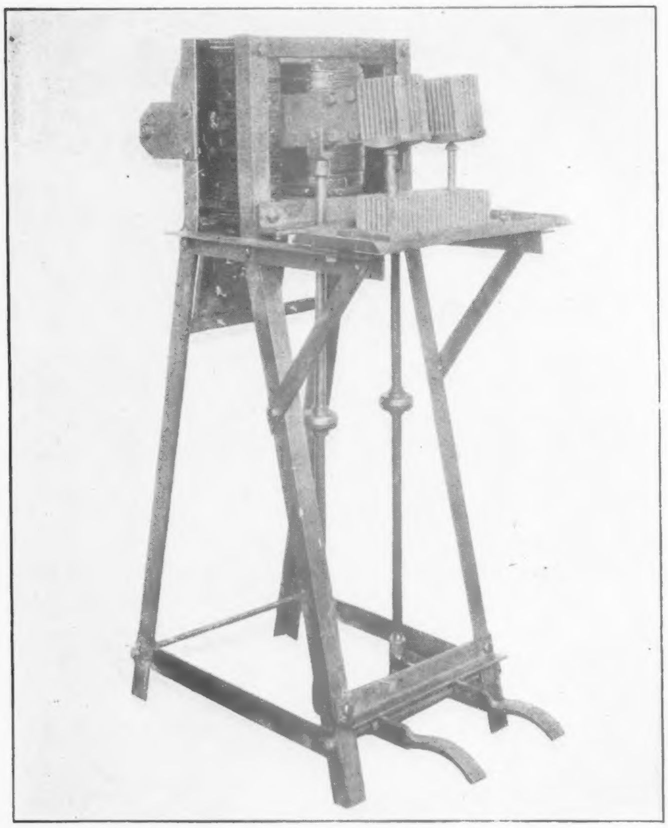
The throttle valve of the motor has a graduated opening, which makes it easy to control the speed of the motor and start or stop it gradually. The motor is reversed by shifting an eccentric, operated by the chains. The cables and drums are placed far apart to prevent the load from twisting or turning. The drums are spirally grooved and a guide on each drum leads the cable into the spiral groove and prevents climbing, crossing and cutting. The cable is protected by the drum covers and attached to the drum with a large radius bend, to prevent its kinking or weakening under heavy strain.

The motor is of the close-quarter drill type and has a relatively small air consumption. The cylinders are double acting and use a single throw balanced crank shaft, which is connected with the worm.

Electric Rivet Heaters for Railway Shops

ELECTRIC rivet heaters possess certain inherent advantages which may cause them to be used extensively in the railroad field. Three of these machines have been recently placed on the market. These are, respectively, the Berwick rivet heater, manufactured by the American Car and Foundry Company, New York; the Humil heater, manufactured by the Humil Corporation, New York, and the General Electric heater, manufactured by the General Electric Company, Schenectady, N. Y.

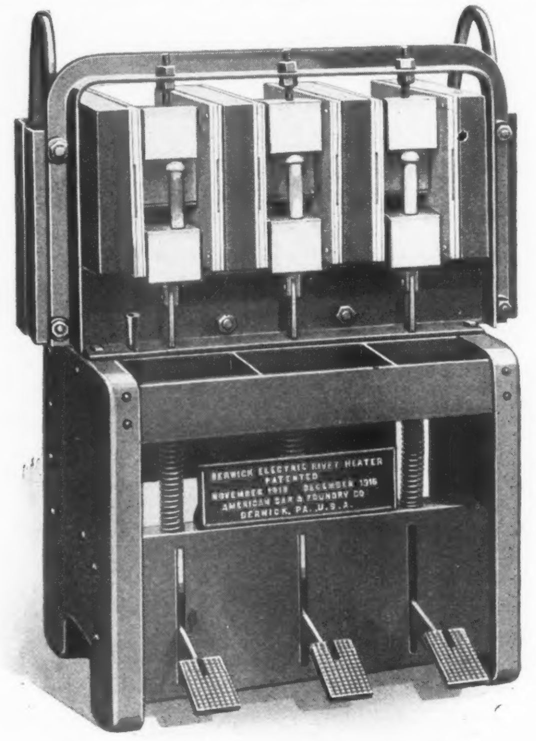
The three machines differ somewhat in details of design, but are similar in principle. They are all of the electric conduction type; the rivets are heated by the passage of an electric current through them. Electrically, the rivet heaters consist of a specially designed transformer. The secondary terminals are heavy copper blocks, between which the rivets to be heated are placed. Suitable means are provided for controlling the current. In the Berwick and Humil machines the rivets being heated are connected in multiple, while in the General Electric machine two rivets are connected in series.



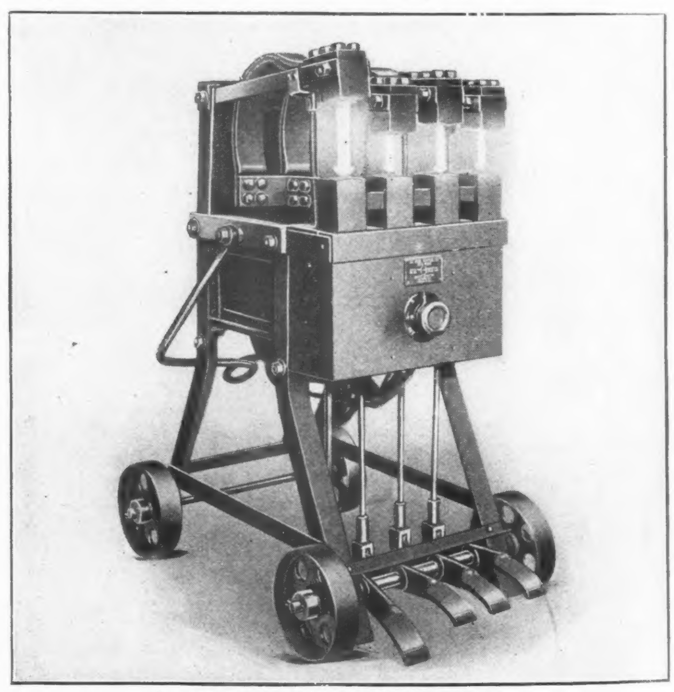
A Two-Head General Electric Rivet Heater

The operation of heating rivets is very simple. The copper blocks which form the secondary terminals are forced apart by a handle or foot treadle, a rivet is placed endwise between the blocks, and on releasing the handle or treadle the blocks are made to grip the rivet by their weight or by springs, depending on the type of machine. A stop prevents the blocks from coming in contact with each other when there is no rivet between them.

The electric furnace is clean, gives off no objectionable gas and the rivets are always in plain view of the operator. The rivet is heated from the inside and the shank becomes hotter than the head, due to its lesser cross section. These are ideal upsetting conditions, as the heat is applied exactly where it is needed, and the head, being cooler, is less malleable and is therefore less likely to be marred by the backing up tool. Rivets can be heated, cooled and reheated a number of times without harmful oxidation and as many as 1,400 rivets can be heated in an hour with a single machine, the hourly capacity depending upon the size of rivet and the number of heating heads on the machine. The machines are built to operate on alternating current supply voltages from 110 to 550; but there is no danger to the operator, as the voltage across the secondary terminals of any of the machines is never more than ten volts. From five to seven pounds of rivets can be heated with a power consumption of one kw. hour.



A Three-Head Berwick Rivet Heater



A Four-Head Humil Rivet Heater

Railway Mechanical Engineer

(*Formerly the* RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated*)

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Subscriptions, including the eight daily editions of the Railway Age, published in June, in connection with the annual convention of the American Railroad Association. Section III—Mechanical, payable in advance and postage free: United States, east of the Mississippi river, $3.00 a year; elsewhere, $4.00 a year; Single copy, 30 cents.

WE GUARANTEE, that of this issue 12,800 copies were printed; that of these 12,800 copies 10,092 were mailed to regular paid subscribers, 20 were provided for counter and news company sales, 239 were mailed to advertisers, 32 were mailed to employees and correspondents, 1,000 were provided for distribution in Atlantic City during the Convention of the Mechanical Section, American Railroad Association, and 1,417 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 73,950, an average of 12,325 copies a month.

THE RAILWAY MECHANICAL ENGINEER is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.).

The shops of the Atlantic Coast Line at Waycross, Ga., were damaged by fire on the night of April 8 to the amount of about $50,000. The fire started in the car repair shops about nine o'clock in the evening and the flames were fought all night. The car shops, and a small blacksmith shop were completely destroyed, together with the combustible portions of 200 box cars. About 500 men were thrown out of work temporarily.

The Board of Railroad Wages and Working Conditions of the United States Railroad Administration was discontinued on April 1. The board since the termination of federal control on March 1, has been engaged solely in completing the tabulation of data relating to railroad wages and working conditions, the collection of which was begun during the period of federal control, and in recommending necessary interpretations involving readjustments chargeable to the director general of railroads for some portion of the period of federal control under the wage orders issued during federal control. This work has now been completed, insofar as the board is concerned. In accordance with Section 311 (c) of the transportation act, all books, papers and documents of the Board of Railroad Wages and Working Conditions will be transferred to the Labor Board created by the transportation act.

A novel method of familiarizing railway men with the manufacture and use of brake beams will be introduced shortly by the Chicago Railway Equipment Company, Chicago, by means of a five-reel film entitled "Brake Beams—Their Manufacture and Use." The film was taken under the supervision of T. A. Le Beau of the Chicago Railway Equipment Company, and traces the developments from the handling of the raw material at the rolling mill until the various parts are assembled into a finished brake beam. Four of the large industrial plants of the country were visited in making the film. It concludes with the brake beam in service showing the damage that results from improperly applied brake beams. It is planned to show the film at various gatherings of railroad executives, at railroad conventions and to groups of workmen, after which it will be sent abroad.

The director of sales of the War Department has sold the remaining 113 of the 200 Decapod locomotives originally built for the Russian government to Cuthell, White, Bayles and Appel, counsellors at law, Washington, for export, under a condition that the locomotives will not be resold to the Russian soviet republic. They will be repaired, altered to 5-ft. gage, be equipped with Russian couplers and boxed for ocean shipment by the Baldwin Locomotive Works. The purchasers are still negotiating for their disposition. The price was $47,710. The 87 locomotives sold to American railroads were sold at $25,000 in consideration of their inaptitude for service on roads in this country and in order to make their purchase as attractive as possible to American railroads to which the entire lot was originally offered. The War Department has also received bids on about 7,500 freight cars, built for military service in France.

New Devices in May Issue

The locomotive recording instrument described on page 306 of the May *Railway Mechanical Engineer* is made by the Speedograph Corporation, Newark, N. J. The relieving attachment described on page 309 of the same issue is made by W. B. Jones, Rochester, N. Y.

A Practical Freight Train Loading Method

In the article by R. S. Mounce, published in the *Railway Mechanical Engineer* for May, 1920, a serious error occurred in the first and third formulae on page 271. The formula for train load should have read as follows:

70-ton cars—

$$\text{Train load (tons)} = \frac{P}{R}$$

20-ton cars—

$$\text{Train load (tons)} = \frac{P}{r}$$

Mechanical Section Scholarships

Two of the four scholarships at Stevens Institute of Technology, which the Mechanical Section of the American Railroad Association offers to sons of members of the section, will be vacant in June. These scholarships cover the regular tuition charges for a four-year course, leading to the degree of mechanical engineer. The course offered also includes instruction in electrical, civil and other branhes of engi-

neering. Applications should be in the hands of V. R. Hawthorne, secretary, Chicago, not later than June 15. In case there are more than two applicants the scholarships will be given to the two passing the entrance examination with the highest standing. Full information will be supplied by the secretary upon application.

Screw Machine vs. Turret Lathe

The Warner & Swasey Company, Cleveland, Ohio, announces a campaign for discontinuing the name "screw machine" when applied to the modern turret lathe. It is explained that the name "screw machine" is no longer appropriate when applied to the modern turret lathe, which is now seldom used for the making of screws, as automatic screw machines of various types serve this purpose better when large quantities are involved. Ten years ago bar work was the main product handled on what was then known as a hand screw machine; but to-day there is more chucking work performed on the turret lathe than bar work. Furthermore, the modern turret lathe is designed and constructed to handle heavy castings and forgings and is provided with sufficient power for machining tough forgings and alloy steel parts. For use merely for making screws, the present power provided in turret lathes would be superfluous.

The Warner & Swasey Company is urging all users and manufacturers to aid in the campaign for dropping the old term "screw machine" when applied to turret lathes.

English Rolling Stock to Be Standardized

Sir Eric Geddes, Minister of Transport, recently outlined the plans of the Ministry of Transport with regard to standardization on the English railroads. He said that the mechanical engineering department of the Ministry was endeavoring to standardize the freight cars, and a commencement had been made by arranging with all railways and all owners of cars that all running gear should conform to certain standards. With regard to the cars themselves, there is not the least doubt that for certain classes of traffic the object to be aimed at is a car of much higher capacity, for this will lead to a great saving in the weight and length of trains, and consequently in the length of new sidings. Larger cars are not, of course, suitable to all kinds of traffic but for coal traffic they would be of enormous value. In deciding on the size of the car to be used, consideration must be given to existing conditions, to the cost of the alterations to be made in the right of way and structures and what economies would result.

As to the standardization of locomotives, Sir Eric Geddes says this is at present limited by the capacity of bridges and roads already built to carry locomotives of a certain size and therefore at present two or even three classes in each type might be allowed for, say light and heavy, or light, medium and heavy, of which parts could be interchangeable and a considerable reduction effected in the number of types.

The mechanical engineering department is also considering the standardization of signaling apparatus, economies in workshops, improvement in the plant and equipment of docks, and economy in the production and use of everything of a mechanical nature connected with transport.

The Mechanical Conventions

The record-breaking attendance which is expected at the Atlantic City conventions has exhausted the reservations at many of the hotels. J. D. Conway, secretary of the Railway Supply Manufacturers' Association, has offered to be of assistance in the matter of securing accommodations and suggests that those who have not yet secured their reservations might find it of value to communicate with his office at 1841 Oliver building, Pittsburgh.

The Supply Association has arranged to have the Hotel Esplanade which is directly beyond the Chelsea opened for the convention. This hotel does not regularly open until July 1. It has 250 rooms with 60 private baths, running water in all rooms and swimming pool in hotel. American plan rates $6 to $10 a day.

There are many good hotels located off the boardwalk, among which are the Wilshire, Craig Hall and the Grand Atlantic.

For those stopping at hotels located some distance from the pier there is good jitney service on Atlantic avenue, one block from the board-walk, where jitneys run every two or three minutes. The fare is 5 to 10 cents and from the Hotels Esplanade or Breakers to the pier is covered in five minutes.

Calendar for the June Convention

The following is the program for the second annual meeting of the American Railroad Association, Section III—Mechanical, to be held at Atlantic City, June 9 to 16, inclusive:

WEDNESDAY, JUNE 9, 1920

	A.M.		A.M.
Prayer	9.30	to	9.40
Address of welcome by mayor of Atlantic City	9.40	to	10.00
Address by the chairman	10.00	to	10.30
Action on minutes of annual meeting of 1919	10.30	to	10.35
Appointment of committee on subjects, resolutions, correspondence, obituaries, etc.	10.35	to	10.45
Unfinished business	10.45	to	10.50
New business	10.50	to	11.00
Report of general committee, including announcement of nominations for members of nominating committee	11.00	to	11.15
Discussion of reports on:			
Nominations	11.15	to	11.30
			M.
Mechanical Stokers	11.30	to	12.00
	M.		P.M.
Modernization of Stationary Boiler Plants	12.00	to	12.30

THURSDAY, JUNE 10, 1920

	A.M.		A.M.
Discussion of reports on:			
Fuel Economy and Smoke Prevention	9.30	to	10.00
Auxiliary or Safety Connections Between Engine and Tender	10.00	to	10.30
Design, Maintenance and Operation of Electric Rolling Stock	10.30	to	11.00
Scheduling and Routing Systems for Locomotive Repair Shops	11.00	to	11.30
			M.
Superheater Locomotives	11.30	to	12.00
	M.		P.M.
Individual paper on "Snow Fighting Apparatus," by W. H. Winterrowd	12.00	to	12.30

FRIDAY, JUNE 11, 1920

	A. M.		A.M.
Discussion of reports on:			
Locomotive Headlights and Classification Lamps	9.30	to	10.00
Feed Water Heaters for Locomotives	10.00	to	10.30
Individual paper on "Locomotives as a Big Investment," by G. M. Basford	10.30	to	11.00
Discussion of reports on:			
Design and Maintenance of Locomotive Boilers	11.00	to	11.30
			M.
Engine Terminals, Design and Operation	11.30	to	12.00
	M.		P.M.
Train Resistance and Tonnage Rating	12.00	to	12.30

MONDAY, JUNE 14, 1920

	A.M.		A.M.
Discussion of reports on:			
Autogenous and Electric Welding	9.30	to	10.00
Specifications and Tests for Materials	10.00	to	10.30
Standard and Recommended Practice	10.30	to	10.45
Election of officers	10.45	to	11.00
Discussion of reports on:			
Repair Shop Layouts	11.00	to	11.20
Amalgamation	11.20	to	11.30
Standard Blocking for Cradles of Car Dumping Machines	11.30	to	11.40
			P.M.
Standard Method of Packing Journal Boxes	11.40	to	12.10
	P.M.		
Establishment of a Co-operative Research Bureau	12.10	to	12.30

TUESDAY, JUNE 15, 1920

	A.M.		A.M.
Discussion of reports on:			
Revision of Passenger Car Rules of Interchange	9.30	to	10.00
Prices for Labor and Materials	10.00	to	10.30
Depreciation for Freight Cars	10.30	to	11.00
Arbitration	11.00	to	11.30
			M.
Tank Cars	11.30	to	12.00
	M.		P.M.
Brake Shoe and Brake Beam Equipment	12.00	to	12.30

WEDNESDAY, JUNE 16, 1920

	A.M.		A.M.
Discussion of reports on:			
Couplers and Draft Gear	9.30	to	9.50
Car Wheels	9.50	to	10.20
Car Construction	10.20	to	10.50
Safety Appliances	10.50	to	10.55
Loading Rules	10.55	to	11.20
Train Brake and Signal Equipment	11.20	to	11.50
			P.M.
Train Lighting and Equipment	11.50	to	12.20
	P.M.		
Subjects	12.20	to	12.30

National Screw Thread Commission Report Approved

The progress report of the National Screw Thread Commission, Washington, has been approved by the commission and is now available. The report covers the standardization of only those threads, sizes, types, and systems which are of paramount importance by reason of their extensive use and utility. Information is given to permit the writing of definite and complete specifications for the purchase of screw thread products, and the application of the specifications is explained in detail.

It is recommended by the commission that the United States standard or Sellers' profile, hereafter to be known as the National Form of Thread, be used for all screw thread work except where otherwise specified for special purposes. The coarse thread series recommended are the present United States standard threads supplemented in the sizes below 1/4 in. by the standard established by the American Society of Mechanical Engineers. The fine thread series consists of sizes taken from the standards of the Society of Automotive Engineers and the fine thread series of the American Society of Mechanical Engineers.

The report establishes for general use four distinct classes of screw thread fits with subdivisions which, together with specifications, are explained as for the purpose of insuring the interchangeable manufacture of screw thread parts throughout the country. Tolerances are given for loose fit, medium fit (regular and special), and close fit. Extensive tables give the tolerances and dimensions for each class of fit. Tolerances and dimensions are included for fire hose couplings and small hose couplings. A complete gaging system which has been found adequate in the production of war material is specified in detail.

Standard Sizes for Shafting

The Council of the American Society of Mechanical Engineers has approved the report of a committee formed to investigate the standardization of shafting sizes and has accepted the following lists of sizes as recommended standards for the society:

Transmission Shafting:

15/16 in.; 1-3/16 in.; 1-7/16 in.; 1-11/16 in.; 1-15/16 in.; 2-3/16 in.; 2-7/16 in.; 2-15/16 in.; 3-7/16 in.; 3-15/16 in.; 4-7/16 in.; 4-15/16 in.; 5-7/16 in.; and 5-15/16 in.

Machinery Shafting:

Size intervals extending to 2 1/2 in., by sixteenth inches; from 2 1/2 in. to 4 in., inclusive, by eighth inches; from 4 in. to 6 in., by quarter inches.

These standard sizes have also been approved by representatives of the following associations: American Hardware Manufacturers' Association, American Railway Engineering Association, American Supply & Machinery Manufacturers' Association, National Association of Manufacturers of the U. S. A., National Association of Purchasing Agents, National Machine Tool Builders' Association, Southern Supply & Machinery Dealers' Association.

It was the opinion of the committee that the adoption of standard sizes of shafting will mean that in the future there will be a gradual elimination of odd sizes from makers' lists and from dealers' stocks, and for new construction only standard sizes would be selected.

MEETINGS AND CONVENTIONS

Association of Railway Electrical Engineers.—The semi-annual meeting of this association will be held at the Hotel Dennis, Atlantic City, on June 14. The meeting will be called to order at 9 a. m. Progress reports will be presented by committees on truck and tractors; electric welding; illumination; train lighting equipment and practice; railway stationary power plants; electric headlights; electrification; electric repair shop facilities and equipment.

American Railroad Master Tinners', Coppersmiths' & Pipefitters' Association.—At the convention of this association, which will be held June 1-4 at the Hotel Sherman, Chicago, the following subjects will be discussed: Headlights and their maintenance, locomotive jackets, manufacturing in locomotive tin shops, steam heat and its upkeep, acetylene welding in the tin shop, spot welding in the tin shop, repairs to steel coaches, methods of babbitting, reclamation of scrap sheet metal, air brake piping.

American Society for Testing Materials.—This society will hold its twenty-third annual meeting at Asbury Park, N. J., on June 22 to 25 inclusive, with headquarters at the New Monterey hotel. The first session will be held at 10 a. m., Tuesday, June 22. Papers and reports will be presented at the various sessions in accordance with the following general outline:

Tuesday morning......	Non-Ferrous Metals.
Tuesday afternoon......	Wrought and Malleable Iron and Corrosion.
Tuesday evening......	Presidential address and reports of administrative committees.
Wednesday morning....	Steel.
Wednesday afternoon...	Committee meetings.
Wednesday evening.....	Testing Apparatus.
Thursday morning......	Preservative Coatings and Lubricants.
Thursday afternoon.....	Miscellaneous Committee Reports and Papers.
Thursday evening......	Ceramics.
Friday morning........	Road, Materials, Lime and Gypsum.
Friday afternoon.......	Golf tournament.
Friday evening.........	Cement and Concrete.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILROAD ASSOCIATION, SECTION III.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Convention, June 9-16, 1920, Atlantic City, N. J.

AMERICAN RAILROAD ASSOCIATION, SECTION VI.—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Convention June 14-16, 1920, Atlantic City, N. J.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. B. Baker, Terminal Railroad, St. Louis, Mo. Convention June 1-4, 1920, Hotel Sherman, Chicago.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting, June 21, 1920. New Monterey Hotel, Asbury Park, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

AMERICAN STEEL TREATERS' SOCIETY.—W. H. Eisenman, 154 E. Erie St., Chicago.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & W. Station, Chicago.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Meetings second Tuesday in month, except June, July and August.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 North Pine Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, secretary, Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York. Meetings second Friday in January, March, May and September and second Thursday in November, Hotel Statler, Buffalo, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—J. C. Keene, Decatur, Ill.

CINCINNATI RAILWAY CLUB.—H. Boutet, 101 Carew Building, Cincinnati, Ohio. Meetings second Tuesday in February, May, September and November.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention Sept. 7-10, 1920, Hotel Sherman, Chicago.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Meetings second Tuesday in month, except June, July, August and September.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York. Meetings third Friday in month, except June, July and August, 29 W. 39th St., New York.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meetings, second Thursday in month, alternately in San Francisco and Oakland.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings, fourth Friday in month, except June, July and August, American Club House, Pittsburgh.

ST. LOUIS RAILWAY CLUB.—J. B. Frauenthal, Union Station, St. Louis, Mo. Meetings, second Friday in month, except June, July and August.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—J. M. Byrne, 916 West 78th St., Chicago. Meetings, third Monday in month, except June, July and August.

PERSONAL MENTION

GENERAL

A. S. ABBOTT has resigned as superviser of tools of the St. Louis-San Francisco, at Springfield, Mo., to become superintendent of motive power of the Miami Mineral Belt at Miami, Okla.

GEORGE S. EDMONDS, recently appointed acting superintendent motive power of the Delaware & Hudson, with headquarters at Colonie, N. Y., has been appointed superintendent motive power, succeeding James H. Manning, deceased. Mr. Edmonds was graduated from Cornell University in 1895. He began railroad work shortly after graduation, in the shops of the New York Central and afterwards served in the road and mechanical engineer's office. He went to the Delaware & Hudson in 1900 as mechanical engineer and was appointed master mechanic in 1905, retaining that position until 1912 when he was appointed shop superintendent. On April 5, 1920, he became acting superintendent motive power and was promoted to superintendent motive power on April 21.

ERNEST V. WILLIAMS, shop superintendent of the Buffalo, Rochester & Pittsburgh, has been appointed superintendent motive power with headquarters at DuBois, Pa., succeeding F. J. Harrison, deceased. Mr. Williams served as apprentice at the Brooks Locomotive Works, Dunkirk, N. Y., and afterwards worked as machinist for the Rome Locomotive Works, Rome, N. Y., prior to beginning railroad work. He then entered the employ of the New York Central as machinist at West Albany, N. Y. Shortly afterwards he was promoted to assistant machine shop foreman at the same place and then to assistant to the superintendent of shops. His next position was that of machine shop foreman, also at West Albany. Later he was transferred to Depew, N. Y., as assistant general foreman, but afterwards he returned to West Albany as general foreman. He went to the Buffalo, Rochester & Pittsburgh on June 1, 1917, to accept an appointment as shop superintendent, the position he filled at the time of his recent promotion.

E. V. Williams

WALKER D. HINES has resigned as director general of railroads, effective May 15, and after a vacation trip abroad he plans to resume the practice of law in New York city. John Barton Payne, Secretary of the Interior, has been appointed to succeed Mr. Hines as director general, to have charge of the liquidation of the Railroad Administration and to act as the agent designated in Section 206 of the Transportation Act. In accepting Mr. Hines' resignation the President wrote that he could not let the director general retire without telling him how he had "personally valued and admired the quite unusual services you have rendered the government and the country." Mr. Hines has been connected with the Railroad Administration since its organization. He was first appointed assistant to the director general and later, when Mr. McAdoo left Washington for an extended trip, he was appointed assistant director general and left in direct charge of the organization at Washington. He was appointed director general to succeed Mr. McAdoo on January 11, 1919. Prior to federal control he was chairman of the board of the Atchison, Topeka & Santa Fe and a member of the law firm of Cravat, Henderson & de Gersdorff.

JOHN M. KINCAID, electrician foreman of the Erie at Hornell, N. Y., has been appointed electrical supervisor for the Hornell region, with office at Hornell.

F. P. PFAHLER, who has been chief mechanical engineer of the Railroad Administration with office at Washington, D. C., has returned to the service of the Baltimore & Ohio as supervisor of locomotive maintenance, with office at Baltimore, and also the mechanical member of a committee appointed to investigate the feasibility of electrifying one or two of its divisions.

F. W. RHUARK has been appointed mechanical superintendent of the Pittsburgh & West Virginia. Mr. Rhuark was formerly master mechanic of the Baltimore & Ohio, eastern lines with headquarters at Connellsville, Pa.

EDWARD A. SWEELEY, a member of Railway Board of Adjustment No. 2, of the Railroad Administration, has resigned to become mechanical superintendent of the Fruit Growers' Express.

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

E. BOWIE has been appointed division master mechanic of the Brownville division of the Canadian Pacific, with headquarters at Brownville Junction, Me., succeeeding W. Wright, transferred.

HARRY L. GETTYS has been appointed master mechanic of the Virginian, with headquarters at Roanoke, Va. He was born on June 16, 1876, at New Hope, Pa., and was graduated from Roanoke High School in 1892. On October 1 of that year he began railroad work in the boiler department of the Norfolk Western and afterwards served a machinist apprenticeship. During the Spanish-American war he enlisted in the United States Navy and afterwards until August, 1905, was in the employ of the government at the Washington Navy yard. He then returned to the Norfolk & Western and was appointed rod gang foreman in 1907, assistant general foreman at West Roanoke in 1908, and from 1909 to 1913 did special work in connection with the cost of handling locomotives. He was then appointed chief inspector of new locomotive construction with the title of mechanical inspector, remaining in that position until 1917. On February 1, 1918, he entered the employ of the Nathan Manufacturing Company, but on March 15, 1920, accepted his present position as master mechanic of the Virginian at Roanoke.

J. E. GOODMAN, who was granted leave of absence a few months ago, has resumed his duties as master mechanic of the Lake Superior division of the Northern Pacific with headquarters at Duluth, Minn. and John A. Marshall, who served as acting master mechanic during Mr. Goodman's absence, has resumed his position as road foreman of engines at Duluth.

A. HAMBLETON, general foreman of the Chicago, Rock Island & Pacific shops at Shawnee, Okla., has been appointed master mechanic at Eldorado, Ark., succeeding W. M. Wilson, resigned to accept service with the Locomotive Firebox Company, Chicago.

C. E. McMILLEN has been appointed road foreman of engines on the Eastern division of the Atchison, Topeka & Santa Fe, with headquarters at Argentine, Kan.

J. K. NIMMO, assistant general boiler inspector of the Western district, Eastern lines, Atchison, Topeka & Santa Fe, has been appointed acting master mechanic of the Oklahoma division, with headquarters at Arkansas City, Kan., succeeding W. J. Hill, assigned to other duties.

VERN C. RANDOLPH has been appointed general supervisor of locomotive operation for the Hornell region of the Erie, with headquarters at Hornell, N. Y.

GEORGE W. RANKIN, formerly assistant master mechanic of the Louisville terminal of the Louisville & Nashville, has been appointed assistant master mechanic at the South Louisville shops of the same road. Mr. Rankin is 32 years old and was born in Pennsylvania. He received his education in the Louisville, Ky., schools, and is a graduate of the manual training high school of that city. He served an apprenticeship in the shops of the Louisville & Nashville, which he completed in 1909 and was subsequently promoted to the position of foreman. He acted in that capacity until 1917, when he was appointed assistant master mechanic of the Louisville terminal, and on March 1, 1920, received his present appointment.

G. W. Rankin

A. R. TEAGUE has been appointed master mechanic of the Mobile division of the Mobile & Ohio at Whistler, Ala., succeeding G. L. Lambeth.

FRED L. VOERGE has been appointed assistant master mechanic of the Montana division of the Northern Pacific, with headquarters at Livingston, Mont.

W. WRIGHT has been appointed division master mechanic of the Farnham division of the Canadian Pacific, with headquarters at Farnham, Que., succeeding R. Walton, transferred.

CAR DEPARTMENT

GLENN A. ALLEN, supervisor of locomotive operation of the Erie at Susquehanna, Pa., has been appointed supervisor of air brakes, with headquarters at Hornell, N. Y.

JOHN F. SOMMERS has been appointed supervisor of car repairs of the Erie, at Hornell, N. Y.

SHOP AND ENGINEHOUSE

H. G. BECKER, general foreman of the Delaware & Hudson at Colonie, N. Y., has been appointed shop superintendent to succeed G. S. Edmonds.

GEORGE GOLDSMITH has been appointed shop superintendent of the Erie at Buffalo, N. Y.

HUMPHRIES W. BREWER, general foreman of the Buffalo, Rochester & Pittsburgh, at DuBois, Pa., has been appointed superintendent of shops at that point, succeeding E. V. Williams. Mr. Brewer was born on December 19, 1881, at Corning, N. Y., where he attended the public schools. On October 12, 1898, he began a machinist apprenticeship with the Fall Brook Railroad at Corning, which he completed after this road was merged with the New York Central. He was then transferred to the Avis shops of the latter road as a mechanic, later being promoted to foreman. Subsequently he went to West Albany and acted as foreman there until July, 1917, when he resigned to accept the position of general foreman of the Buffalo, Rochester & Pittsburgh at DuBois, which he held until he received his recent appointment.

PURCHASING AND STOREKEEPING

G. W. BICHLMEIR has been appointed purchasing agent of the Kansas City Southern, with office at Kansas City, Mo., succeeding W. S. Atkinson, resigned.

D. C. CURTIS, prior to federal control inspector of stores on the Chicago, Burlington & Quincy, and during federal control storekeeper for the Northwestern Regional Purchasing Committee, has been appointed general storekeeper of the Chicago, Milwaukee & St. Paul, with headquarters at Milwaukee shops, Wis., succeeding F. J. O'Connor, who has been assigned to other duties.

W. J. DIEHL, general storekeeper of the Mobile & Ohio, with headquarters at Mobile, Ala., has been appointed purchasing agent, with the same headquarters, succeeding J. A. Turner, resigned. The office of general storekeeper has been abolished.

G. W. LEIGH, assistant general storekeeper on the Minneapolis, St. Paul & Sault Ste. Marie, at Minneapolis, Minn., has been appointed general storekeeper, with the same headquarters, succeeding T. W. Flannagan, promoted.

W. A. SUMMERHAYS, assistant purchasing agent of the Illinois Central, with headquarters at Chicago, has been appointed purchasing agent, with the same headquarters.

E. W. THORNLEY, formerly supervisor of stores, United States Railroad Administration, has been appointed assistant purchasing agent of the Baltimore & Ohio, with headquarters at Baltimore, Md.

OBITUARY

CHARLES F. JACOBSON, motive power inspector for the New York Central Lines in the fourth inspection district, with headquarters at Elkhart, Ind., died at his home in Elkhart on March 25.

GEORGE H. GILMAN, master car builder of the Northern Pacific, with headquarters at St. Paul, Minn., died on February 27 after a short illness. Mr. Gilman was born at McArthur, Ohio, on April 11, 1862. He began railroad work as a car carpenter on the Northern Pacific when 22 years old. In October, 1884, shortly after entering the employ of that road, he was promoted to car foreman. While serving in that capacity he was transferred several times to different places. He was appointed shop superintendent and master car builder at the Como shops in 1903, and on November 26, 1905, his title was changed to master car builder.

THOMAS J. BURNS, superintendent rolling stock of the Michigan Central, with headquarters at Detroit, Mich., died in that city on April 18. Mr. Burns was born at Hillsdale, Mich., on July 24, 1868. He graduated from Assumption College and spent some years at Grand Seminary, Montreal. His first railroad work was as clerk in the maintenance of way department of the Michigan Central at Bay City, Mich. He became engine despatcher on November 1, 1896, and was appointed chief clerk to the master mechanic at Jackson, Mich., on December 15, 1902. In August, 1905, he was transferred to Detroit, Mich., as chief clerk to the superintendent motive power, and was appointed assistant superintendent motive power on June 1, 1912. In 1915 he was appointed to the position he held at the time of his death.

SUPPLY TRADE NOTES

The Grip Nut Company, Chicago, has opened a new plant at 5917 Western avenue, Chicago.

Arthur Benedict Bellows, first vice-president of the Pittsburgh Testing Laboratory, Pittsburgh, Pa., died on April 17.

The United States Gauge Company has moved its general sales office from 67 Wall street, to 37-39 Liberty street, New York.

Roger C. Sullivan, chairman of the board of directors of the Independent Pneumatic Tool Company, Chicago, died on April 14.

A. C. Moore has been appointed assistant to the president of the Globe Seamless Steel Tubes Company, Chicago, with headquarters at Chicago.

The Jerome-Edwards Metallic Packing Company, Chicago, Ill., recently removed to its new factory at 3136-3138 W. Chicago avenue, Chicago.

The Independent Pneumatic Tool Company, Chicago, has removed its Detroit, Mich., offices from 736 David Whitney building, to larger quarters at 55 Garfield building.

G. B. Albright, has been appointed manager of the railway department for the western district, of the Lowe Brothers Company, Dayton, Ohio, with headquarters at Chicago.

Daniel Cram Noble, president and treasurer of the Pittsburgh Spring & Steel Company, Pittsburgh, Pa., died at his home in that city on May 8, at the age of 75. He was born in Baldwin, Me., on August 5, 1845, and was educated at Hebron Academy, Maine. For more than 25 years Mr. Noble was identified with branch lines of the Pennsylvania Railroad. He went to Pittsburgh in 1868, and in 1880 became associated with the A. French Spring Company of that city, remaining with that company until 1902, when he founded the Pittsburgh Spring & Steel Company. At the time of his death Mr. Noble was a director of a number of banks and insurance companies of Pittsburgh.


D. C. Noble

On April 26 the New York office of the Electric Storage Battery Company was moved from 100 Broadway to the National Association building, 23-31 West Forty-third street.

B. H. Forsyth, salesman for the Grip Nut Company, Chicago, has been appointed manager of the Pittsburgh office of the Chisholm-Moore Manufacturing Company, Cleveland, Ohio.

John Wesley Hyatt, inventor of the Hyatt roller bearing, died on May 10, at his home in Short Hills, N. J., at the age of 83. Mr. Hyatt was not connected with the Hyatt Roller Bearing Company, having sold the patent for this invention about 25 years ago.

George F. Griffin, son of the late Thomas A. Griffin, founder of the Griffin Wheel Company, and a director of that company, died on May 4 at Miami, Fla., at the age of 39 years.

A. B. Burgess, sales manager of the Powell Machine Company, Worcester, Mass., has been appointed eastern representative of the Houghton Elevator & Machine Company, Toledo, Ohio.

On April 30 the New York office of the Sunbeam Electric Company (formerly Schroeder Headlight & Generator Company), Evansville, Ind., was moved from 50 Church street to 52 Vanderbilt avenue, New York.

Frank P. Roesch has been appointed western manager of the Standard Stoker Company, Inc., New York, and has charge of the Chicago office of the company, which was recently opened at 1549 McCormick building, for the purpose of handling the newly developed Du Pont type locomotive stoker. Mr. Roesch was during federal control connected with the United States Railroad Administration as regional fuel supervisor for the Northwestern region and prior to that was employed as master mechanic on the El Paso & Southwestern, the Southern, and the Chicago & Alton. Mr. Roesch is a member of the American Society of Mechanical Engineers and several of the prominent mechanical department associations, and has contributed a number of articles to the columns of the *Railway Mechanical Engineer.*


F. P. Roesch

F. R. Bolles, formerly vice-president and general manager of the Copper Range Railroad, Houghton, Mich., has been appointed vice-president and general manager of the American Automatic Connector Company, Cleveland, Ohio.

J. F. McDonnell, who for the past nine years has been connected with the Dearborn Chemical Company, has been appointed special railroad representative of the packing department, mechanical rubber division of the United States Rubber Company, with headquarters at Chicago.

The officers of the Elvin Mechanical Stoker Company, 23 West Forty-third street, New York, are as follows: Frank H. Clark, president; John R. Given, vice-president; A. G. Elvin, treasurer; Frederick P. Whittaker, secretary; J. Snowden Bell, patent attorney, 149 Broadway, New York.

Carl G. Barth, a pioneer in the machine building industry, has been elected an honorary member of the Taylor Society, New York, which was organized for the promotion of science in management. Since 1899 Mr. Barth has been associated with Frederick W. Taylor at Bethlehem, Pa., conducting experimental work on the fundamental formulas in cutting metals.

J. W. Austin has been elected a member of the Detroit Graphite Company, Detroit, Mich., with the title of assistant secretary. He is well known throughout the paint and varnish industry, having been for 20 years with the Acme White Lead & Color Works, during the past 15 years as general purchasing agent of that company. In addition to other du-

ties in the Detroit Graphite Company, Mr. Austin will direct the purchasing policy for both its Detroit and allied Canadian plants.

The partnership lately existing between L. H. Turner, Jr., and L. W. Garratt, under the name of L. H. Turner, Jr., & Co., dealers in railway equipment, having been terminated by the recent death of Mr. Turner, the business will henceforth be conducted by Mr. Garratt as its sole proprietor, under the name of L. W. Garratt, 358 Union Arcade, Pittsburgh, Pa.

Frank C. Smink, formerly for 17 years president of the Reading Iron Company, Reading, Pa., died on March 3, of a complication of diseases, at his home in Reading, at the age of 74. After an early training with the Philadelphia & Reading Railway Company and in Reading banking circles, Mr. Smink, in 1878, entered the service of the Reading Iron Works, as business manager. He remained in that position until the organization of the Reading Iron Company in 1889, when he was made treasurer, and subsequently served as vice-president and general manager under the presidency of the late George F. Baer, whom he succeeded in 1902. Mr. Smink was a director of the Reading Trust Company, also the Temple Iron Company, and for many years served as a member of the executive committee and a director of the Pennsylvania Steel Company, the Spanish-American Iron Company, the Maryland Steel Company, the Penn-Mary Coal Company, the Pure Oil Company, and other organizations.

F. C. Smink

In the issue of March, 1920, an erroneous statement appeared regarding arrangements which the Cincinnati Shaper Company was making for the handling of its foreign business. A representative of the company has gone abroad to demonstrate its machines in various plants on the Continent, but no change is to be made in its present foreign agency connections. The president of the company is P. G. March.

George A. Price has been elected treasurer of the American Arch Company, 30 Church street, New York. Mr. Price started work on the New York Central & Hudson River in the motive power department, at the DeWitt enginehouse, and from there was transferred to the office of the superintendent of motive power of the New York Central. In August, 1912, he resigned to enter the service of the American Arch Company. On March 1, 1918, he was elected assistant secretary, and he has now been elected treasurer. In addition to being treasurer Mr. Price will also continue his duties as assistant secretary.

Fred T. Ley, formerly president of the Napier Saw Works, Inc., Springfield, Mass., is the president of a new company organized to take over the band saw and band saw machine business of the Napier Saw Works, Inc. The new company will be known as the Metal Saw & Machine Company, Inc., Springfield, Mass. Mr. Ley will have associated with him as treasurer and general manager, Henry M. Blanchard. The schedule for the present year calls for a production of several hundred machines and it is anticipated that as many as 2,000 machines will be turned out in 1921.

Peter P. Beck, dealer in railway and manufacturers' supplies, removed his office and showroom on May 1, from 105-107 Chambers street, New York, to 22 Thames street. Mr. Beck is sales agent at New York for the Bettendorf Company, Bettendorf, Iowa; Wine Railway Appliance Company, Toledo, Ohio; Railway Brake Specialties Company, Toledo, Ohio; Slick-Knox Steel Company, Sharon, Pa.; Sturdi-Truck Manufacturing Company, Holyoke, Mass.; Liberty Tool Corporation, Baltimore, Md.; Howe Waste & Packing Company, Providence, R. I.; Wm. A. Tottle & Company, Baltimore, Md.; and the Nu-ex Fire Appliance Company, Columbus, Ohio.

The Victor Saw Works, Springfield, Mass., has been purchased by New York banking interests and new officers elected as follows: President, Winthrop Sargeant, Jr.; vice-president and general manager in charge of operation, George J. Siedler; treasurer, Louis J. Oswale; secretary, William P. Jeffery. W. F. Pollock will remain with the company as assistant manager. The Napier Saw Works, Springfield, Mass., has also been acquired by the same interests, the purchase taking in the hack saw blade business, good will and equipment, but not the plant. The old owners of the Napier works retain the factory and the band saw and band saw machine end of that business.

Harry U. Morton, whose appointment as president and treasurer of the Dunbar Manufacturing Company, Chicago, was announced in the May issue, was born on April 25, 1866, in Painesville, Ohio. He entered railway service in 1891 with the Pullman Company, remaining with that company for 17 years of which he served four years in the manufacturing department and 13 years in the operating department. In 1907 he was appointed vice-president and general manager of the General Railway Supply Company. Seven years later he was appointed vice-president and secretary of the Acme Supply Company, Chicago, the corporate name of this company being changed in 1917 to the Dunbar Manufacturing Company. On April 1 of this year he was elected president and treasurer of the latter company succeeding Thomas Dunbar, who has resigned.

H. U. Morton

The Westinghouse Union Battery Company was recently organized in Pittsburgh, Pa., to produce storage batteries for every industry in which batteries are used. The company will specialize in starting and lighting batteries for renewal in automobiles, although the complete line will include batteries for trucks, tractors, motor boats and airplanes; also for home lighting systems, train lighting and railway signals. A. L. Humphrey, president of the Westinghouse Air Brake Company, and active in the management of all of its subsidiary organizations, is chairman of the board of directors of the new company. D. F. Crawford, vice-president and general manager of the Locomotive Stoker Company, is president of the new company, and T. R. Cook, formerly chief engineer and general production manager of the Willard Storage Battery Company, is vice-president and general manager. T. S. Grubbs, vice-president of the Union Switch &

Signal Company, is also vice-president and secretary and treasurer of the new organization.

The Carborundum Company, Niagara Falls, N. Y., is carrying out improvements at a cost of about $500,000, extending and improving its plant at Niagara Falls and its two furnace plants, one at Niagara Falls, Ont., and the other at Shawinigan Falls, Que. A three-story addition to the paper and cloth plant at Niagara Falls has just been finished; it is 432 ft. long and 81 ft. wide and will provide greater facilities for the storing and curing of all carborundum, Garnet and Aloxite paper and cloth products and for the extension of the rubber bonded wheel department. Another addition, just completed, extends one of the wheel-making and kiln departments, the new building being two stories high, 96 ft. long and 64 ft. wide. Both of these new structures are of concrete and are of the most modern type. Other extensions and improvements have been planned and work will be started immediately. These call for additions to the crushing departments and other improvements at the furnace plant at Niagara Falls, Ont., where the abrasive Aloxite is made, and at Shawinigan Falls, Que., where is located an extensive carborundum furnace plant. Besides these buildings the program calls for the extension of at least 14 different departments at the Niagara Falls, N. Y., plant.

This company has also acquired the plant formerly operated by the Didier-March Company at Perth Amboy, N. J., where it will manufacture a complete line of carborundum refractories. The plant is located on a site of 24 acres and consists of a modern clay working and refractory plant with a capacity of about 100 tons a day, covering a floor space of about 300,000 sq. ft. In addition to this property the Carborundum company has purchased 60 acres of high grade fire clay lands at Bonhamton and a clay excavating plant.

J. J. Thomas, Jr., formerly superintendent of motive power and car equipment of the Mobile & Ohio, at Mobile, Ala., has been appointed district manager of the Oxweld Railroad Service Company, Chicago, with headquarters at Mobile. Mr. Thomas entered railway service in 1881 as a fireman on the Selma, Rome & Dalton, now part of the Southern, later becoming a machinist apprentice on the same road. From 1885 to 1898 he was successively locomotive engineer, machine shop foreman general foreman and master mechanic on the Birmingham & Atlantic. In 1898 he was appointed master mechanic on the Mobile & Ohio, with headquarters at Tuscaloosa, Ala., and was later promoted to assistant superintendent of motive power and car equipment, with headquarters at Mobile. In 1902 he was appointed master mechanic of the Seaboard Air Line, with headquarters at Savannah, Ga., resigning some time later to become master mechanic on the Atlantic Coast Line, with headquarters at South Rocky Mount, N. C. He was appointed superintendent of motive power and car equipment on the Mobile & Ohio in 1909, which position he held until the time of his appointment as district manager for the Oxweld Railroad Service Company.

J. J. Thomas, Jr.

TRADE PUBLICATIONS

TRUCTRACTOR.—The Clark Tructractor Company, Chicago, has issued a pamphlet showing photographs and specifications of all models of the Clark Tructractor, with illustrations showing it at work in various industrial plants.

TOOL STEEL.—A brief discussion of the question whether chemical analyses are of greater importance in the quality of tool steel than its careful manufacture in all processes, is printed in a pamphlet of eight pages published by the Vanadium-Alloys Steel Company, Pittsburgh, Pa.

PNEUMATIC BRAKE EQUIPMENT.—The Westinghouse Air Brake Company, Pittsburgh, Pa., has issued catalogue 2021, which briefly describes and illustrates the standardized UC Westinghouse brake equipment for steam road passenger trains, which, with simple electric attachments, is said to represent the most improved form of electro-pneumatic train brake for both electric and steam road passenger trains.

COWAN TRANSVEYOR.—A booklet of 28 pages, entitled Transveyor Picture Book, is being distributed by the Cowan Truck Company, Holyoke, Mass. It shows by means of illustrations the work that these transveyors are doing in a great variety of industries where they are being used. It also points out the advantages of their construction and contains specifications for all types.

ARCH TUBE CLEANERS.—A revised catalogue of locomotive arch tube cleaners (W-4) has been issued by the Lagonda Manufacturing Company, Springfield, Ohio. The catalogue goes into the subject of arch tube cleaning and describes the different types of standard cleaners made by this company, giving a description of their general construction and usage. It also illustrates repair parts and covers briefly several other products.

INGOT IRON WIRE.—The Page Steel & Wire Company, New York, has published a complete pamphlet describing fully the electrical and physical properties of American ingot iron wire. This is the first complete publication of this data and the result of many tests made during the past two years under the supervision of the Electrical Testing Laboratory, New York, and Frank F. Fowle, consulting electrical engineer for this company.

PORTABLE MACHINE TOOLS.—The Pedrick Tool & Machine Company, Philadelphia, Pa., has issued a comprehensive, well-illustrated catalogue of 96 pages, describing the special machine tools manufactured by the company for use in railway shops, shipyards and general machine shops. Among the tools of special interest to railroad men may be mentioned the portable cylinder boring bar, column boring bar, duplex horizontal boring machine, portable crank pin-turning machine, locomotive pedestal jaw facer and pipe-bending machine.

TANK CAR CENTER SILLS.—The Pennsylvania Tank Car Company, Sharon, Pa., describes its type A-1 center sill in a booklet entitled "One Reason Why Pennsylvania Tank Cars Are Used by Leaders of Industry." Although the booklet briefly describes the construction of the sill, it deals principally with tests conducted by Professor Endsley of the University of Pittsburgh at the testing laboratory of the Union Draft Gear Company in December, 1918, to determine the relative strength of the type A-1 center sill, which is patented and used exclusively by the Pennsylvania Tank Car Company, and the type A center sill, now in general use. The booklet contains a number of illustrations.